User's Manual

Model P-150

Impact Printer

BELL & HOWELL

7100 McCormick Road, Chicago, Illinois 60645 (312) 673-3300



P-150

USER'S

REFERENCE

MANUAL

Bell & Howell P-150 User's Reference Manual

Copyright © 1982,1983 by
Bell & Howell
Chicago, Illinois 60645
All Rights Reserved

By

Richard Hevron

PREFACE

The Bell & Howell P-150 is a wide carriage printer designed specifically for mini and micro business systems. The P-150 features a heavy duty print head rated for continuous duty with an expected lifetime of over 100,000,000 characters.

Characters are printed bidirectionally in a logic seeking mode which optimizes system thruput. Nine ballistically driven print wires form crisp, clear characters with true descenders and underlining capability. The P-150 prints a full 136 character line at 10 characters per inch or by selecting the 17 character per inch density, up to 231 columns may be printed. This allows full 136 column printouts to be condensed to fit on standard 8.5 inch wide paper.

Double wide characters can be software selected in any of the character densities for a total of eight different selections. All printing and interface functions are placed under the direct control of a sophisticated microprocessor. The standard 2K buffer can be expanded to 4K. In addition, an optional auxiliary memory may be installed to provide up to 64K bytes of additional buffer.

A 7 x 9 matrix font is used for high speed data printing while an 11 x 9 serif style matrix font is used for applications requiring a high quality correspondence printout. A standard 96 character US ASCII set with three additional selectable language character sets are standard in each unit. Special fonts may be either down line loaded into RAM memory, or permanently located in ROM memory.

High resolution dot addressable graphics capability is included for those applications requiring plotting, printing of screen graphics, drawing of illustrations, and producing special characters or identification marks. The horizontal aspect ratio of the graphics printout can be varied through selection of one of five horizontal dot densities.

Forms handling is implemented with a tractor drive paper feed system which can be adjusted to accept forms ranging from 3 inches to 15 inches in width. Selectable forms lengths and a Skip Over Perforation feature provide for the precise paper handling required for business applications. Formatting requirements are simplified through the inclusion of Horizontal and Vertical Tabbing features. The combination of forms capability and the selectable character densities allows the user to meet a wide range of applications with the Bell & Howell P-150.

'TRS-80' is a trademark of
Radio Shack
A Division of Tandy Corporation
Fort Worth, TX

'Apple' is a trademark of
Apple Computer Inc.
Cupertino, CA

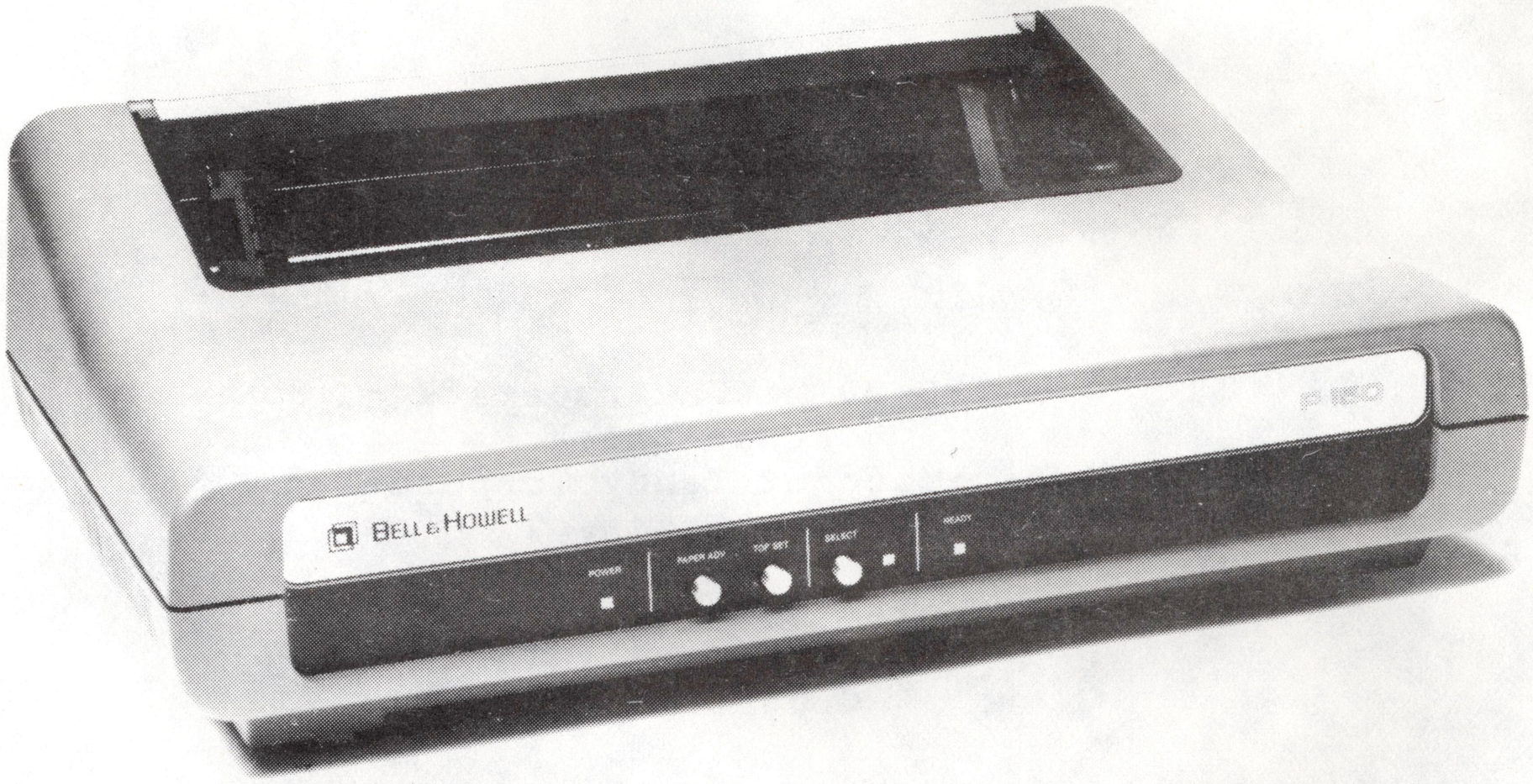
'Centronics' is a trademark of
Centronics Data Computer Corp.
Hudson, NH

'PET' is a trademark of
Commodore Business Machines, Inc.
Santa Clara, CA

'P-150' is a trademark of
Bell & Howell
Chicago, IL

'DEC' is a trademark of
Digital Equipment Corporation
Maynard, MA

P·150


BELL & HOWELL
POWER
PAPER ADV
TOP SET
SELECT
READY
P 150


BELL & HOWELL
pp 150
STATUS
ONLY
X-TAB
Y-TAB
FORM LENGTH
CHAR DENSITY
PERF SKIP
ENTER

PP·150

TABLE OF CONTENTS

1. INTRODUCTION

2. GENERAL DESCRIPTION

- The Print Mechanism 1
- The Control Electronics 2
- The Casework 4
- The Power Supplies 4
- Internal Layout 4

3. INTERFACING

- Parallel 6
- Serial 11
- RS232C Operation 12
- Serial Interface Card Installation 13
- Dip Switches 15
- Serial Protocols 16
- DTR/BUSY Protocol 16
- X-ON/X-OFF 18
- Setting Baud Rate 20
- Baud Rate Selection
  - PP-150 20
- Baud Rate Selection
  - P-150 21
- Automatic Baud Rate Selection
  - PP-150 22
  - P-150 23
- Serial Adapter Card Parity 24
- Interface Signals 25
- Current Loop Operation 26
- IEEE 488 26
- IEEE Centronics 26
- IEEE 488 Peripheral Addressing 27

4. INITIALIZATION

- P-150 without SoftSwitch Keypad 30
- PP-150 with SoftSwitch Keypad 33

- Keypad Examples 33
  - Form Length Select 34
  - Character Density 34
  - Horizontal Tab 34
  - Vertical Tab 35
  - Skip Over Perroration 36
  - Character Sets 36
  - Auto LF on CR 37
  - Print Initialization Status 37

5. PROGRAMMING

- Programming Considerations 39
- Print Line Termination 40
- Ascii Internal Code 42
- Print Command Formats 42
- Programming the P-150
  - SoftSwitch Keypad Commands 43
  - Programmatic Control 43
  - Keyboard Programming 45
  - Issuing Commands from Word Processors 47
- Single Character Commands 47
- Multiple Character Commands 49
- Program Control Examples 51
- Down Line Loading Fonts 54
- Font Data Definition 54

6. GRAPHICS

- Getting Started 61
- Example Graphics Programs 64
- Active Commands 66
- Non-active Commands 67
- Additional Considerations 67

7. PERIODIC MAINTENANCE

- Ribbon Change 69
- Paper Change 70
- Lubrication 70
- External Cleaning 71

8. TROUBLE SHOOTING

- Unit Dead
  - PP-150 72
  - P-150 72

- Garbled Data 74
- System Hanging 74
- Lost Characters 75
- Line Feed Problems 75
- Fading Print 76
- Head not Moving 76
- Characters Jammed Together 76
- Unpredictable Mode Change 76
- Final Testing 77

APPENDICES

---

1. Unpacking & Inspection
- Inspection 78
- Physical Description 79
- Cover Removal 82
- Ribbon 82
- Paper Alignment 83
- Power Connection 84
- Power On 84
- Manual Controls 85
  - Select Switch
  - Paper Advance Switch
  - Top Of Form Switch
- Connection to Host 87

2. Graphics Patterns 89
3. Ascii Code Chart 90
4. Reference Card - Back Cover

*** DISCLAIMER ***

Bell & Howell engages in a continual research and development program to make its products even better. As a result, evolutionary changes in the appearance or specifications of the P-150 will be made from time to time.

INTRODUCTION

Bell & Howell would like to congratulate you on your selection of the Bell & Howell P-150 printer and to thank you for the purchase of their product.

The Bell & Howell P-150 represents the most advanced home and small business printer for micro and mini computer systems offered in today's marketplace. It incorporates the latest technological innovations and features which were available at the time of its manufacture; and it will provide you with years of reliable and quality service.

This manual will help you from the time you unpack your printer through the most sophisticated of printing or graphics applications. Please read it with considerable attention. This may require that you reread those chapters which address areas for which you will be using the printer. Although the Bell & Howell P-150 is designed for easy installation and use, you will greatly help yourself by keeping this manual close at hand for quick reference.

The manual is organized in a logical manner. The first information you will need, Unpacking and Inspection is conveniently located in Appendix 1. Refer to this section first. Then after the printer is ready for use, the manual will cover not only the use of the printer but general reference material about dot matrix printers. The manual covers the P-150's initialization, interfacing, programming, graphics, maintenance and trouble shooting. The appendices contain important summary information.

Please complete the owner registration and warranty form and return it to Bell & Howell. This registration ensures that you will receive your proper warranty coverage and other information from Bell & Howell.

Finally, Bell & Howell has developed an extensive and reliable service organization to support its family of products. Its management and staff are prepared to offer you timely and efficient response to your inquiries or problems in the unlikely event they should occur.

General Description

The Bell & Howell P-150 Printer System is a self contained unit that combines an efficient mechanism with highly advanced electronics to produce a truly state of the art printer.

The P-150 Printer is available in two basic models, the PP-150 and the P-150. The P-150 printers have internal DIP switches to establish the initialization mode of the printer. The PP-150 printers have the SoftSwitch Keypad on the front panel.

This keypad option allows the operator to change the printer modes without removing the top cover of the PP-150's casework. Top cover removal is necessary to manipulate the DIP switches in the P-150. Both the SoftSwitch Keypad and the DIP switches establish the mode in which the printer powers up. The mode may subsequently be changed at will under program control. Both P-150 models are available with varying memory capacities.

The P-150 system is composed of several major sub-systems. The following brief descriptions are intended to give you a quick overall view of their role in the P-150. Each of the sub-systems will be discussed in much greater detail later in the manual.

The major sub-systems are:

- Print Mechanism
- Control Electronics
- Casework
- Power Supply

THE PRINT MECHANISM

The P-150 uses an extremely rugged and reliable print mechanism. Two stepper motors are used in the print mechanism. The first is used for moving the print head, the second is used to advance the paper. The two motors operate independently and are controlled by the microprocessor. The Bell & Howell P-150 uses a nine element printing head that is moved across the printing area by a stepper motor.

An ink ribbon is self contained in a cartridge. The cartridge may be easily replaced by the operator without opening the printer case.

THE CONTROL ELECTRONICS

A powerful customized microprocessor is the heart of the control electronics, and is responsible for the extreme versatility found in the P-150.

Printing is a measured function that begins as soon as the print head leaves its home position at the left end of its travel path. The speed of the print head is constant as it crosses the printing area. Positional feedback is received by the microprocessor through an analysis of the energy absorbed by the head drive motor during each step of the motor.

Character printing is always done BIDIRECTIONALLY. In the graphics mode, printing is always done UNIDIRECTIONALLY. In the unidirectional graphics print mode, printing is always done as the print head moves from left to right.

The actual printing speed, that is the speed at which dots are produced, is constant. This means that the linear speed at which the print head is moved across the page is varied based on character densities and different fonts. For example, the speed at which the print head moves to produce a 136 column line is ten inches per second at 10 CPI density.

Print head positioning is determined by processor control. If more than six blank spaces are detected, the print head performs a high speed slew to the next printable character position.

The P-150 contains internal memory buffers to temporarily hold the characters before they are printed. Printing does not start until a printable line of data is sent to the printer. When data is sent to the printer, it is stored, one character at a time in the printers internal buffer. The standard P-150 is supplied with a 2K character buffer. Optionally, the memory buffer may be expanded to 4 K, and up to 68K with a MemoryMate expansion card.

After data characters are sent to the printer and stored in its buffer, the printer prints characters from the buffer in the conditions discussed in the section on programming.

When the printer buffer contains a line to be printed, and the appropriate command has initiated printing, the buffer is retained in a ready-to-receive state so that additional characters may be sent to the printer while the printer is printing.

The host can send printable information to the printer and then proceed to prepare additional information while the printer is emptying its buffer. This overlap of printing and processing is accomplished by the printer, automatically. Commands are sent to the printer as part of the data stream intermixed with printable data characters.

The print operating sequence is as follows:

1. Starting with the buffer empty, data characters are sent to the printer. The data characters are stored in the buffer. No printing takes place, until:

2. A command character to force printing (i.e. Carriage Return, Line Feed, a full line of characters, etc.) is received in the data stream. This character is examined as it is received and it is stored in the buffer also. The printer now starts printing. Printing continues with one character at a time being removed from the buffer until the print forcing command character is reached.

3. If the print buffer is now empty, the printer stops.

4. If there are command characters in the buffer, they are executed.

5. If there is less than one full line of printable data in the buffer, all the characters in the buffer are scanned to see if there is a print forcing command (CR, LF, etc.) in the buffer. If there is such a command, the printer begins printing the next line. If there is no such command, the printer stops until such a command is reached.

6. If there is more than a full line of printable data in the buffer, the printer's microprocessor will automatically insert a CR into the buffer.

7. The printer buffer operates in a First In, First Out (FIFO) mode. Characters are fed into the buffer as they are generated by the host. Characters are removed from the buffer as fast as the printer can process them. When a line of data is printed, the buffer space it occupied is immediately available for new data.

A software generated FIFO buffer is used to average the character rate and will permit transmission of messages at any of the selected baud rates as long as adequate time fill is allowed between successive messages. If there is a possibility that the data could over-run the printer (i.e. the data being sent to the printer faster than it can be printed) then a "handshake" signal (BUSY, RTS, ACK) should be used to slow the data transfer rate.

THE CASEWORK

The various components that make up the P-150 are housed in a smooth and functional case molded of impact resistant styrene. The case is divided into two sections and the top is easily removable for initializing the internal DIP switches used on P-150s. The I/O cable exit is so formed as to allow the use of ribbon or round cable. I/O connectors and the DIP switches may be mounted on the rear panel as options.

THE POWER SUPPLIES

All electrical power components, from the wall plug and cord to the internal components, are of the highest possible quality and meet or exceed government regulatory standards.

The power supply operates with either 50 or 60 Hz power. The P-150 is supplied as standard with a transformer set up for 115 VAC (+/- 10%). An optional dual primary transformer allows the use of either 115 VAC or 230 VAC (+/- 10%) power.

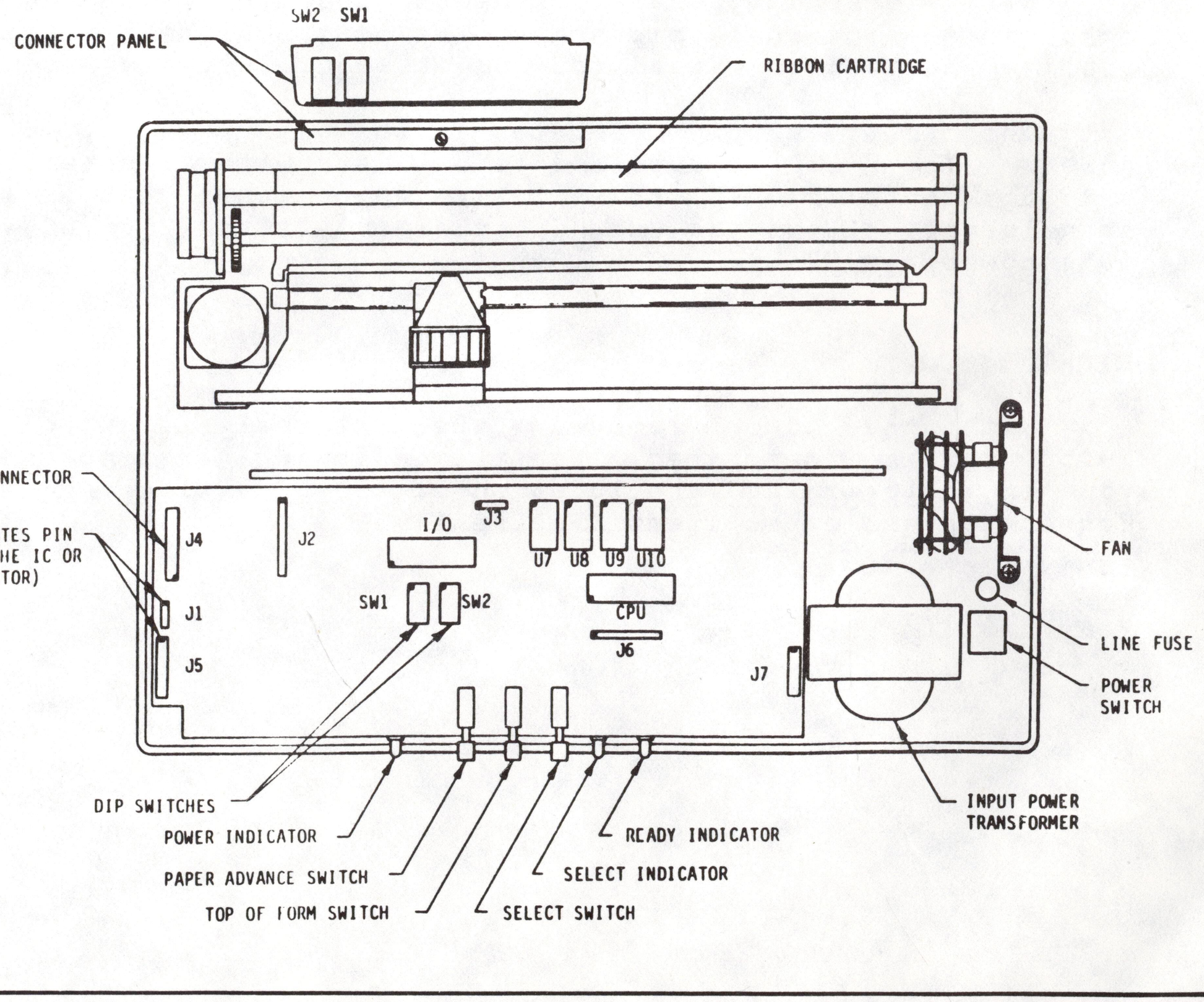
INTERNAL LAYOUT

With the cover removed, the internal layout of the P-150 can be described. Use the following table to assist you in determining the location of the DIP Switches, Cable Connection and other items.(Figure 1)

DESIGNATOR	FUNCTION
J1	Line Feed Motor Connector
J2	Adapter Card Connector
J3	Out of Paper/OPTO Sensor Switch
J4	Host I/O Cable Connector
J5	Print Head Motor Connector
J6	Head Wire Connector
J7	Power Transformer Connector
U7	RAM
U8	Option Dependent RAM/ROM
U9	Option Dependent RAM/ROM
U10	ROM

Familiarize yourself with the location of the Fuse, Power Switch and the front panel's switches and indicators as described in Appendix 1.

Figure 1 - Internal Layout



INTERFACING

This chapter deals with the electrical interfaces between the P-150 and its host. For maximum flexibility, the Bell & Howell P-150 Printer has been designed to communicate using several industry standard interfaces. The P-150 is offered with one of three interfaces. The standard interface is Parallel (7 bit ASCII). The two optional interfaces are Serial (RS232C or Current Loop), and IEEE 488.

Parallel (Standard Interface)

Parallel communications with the P-150 is a buffered, bit parallel, character serial transmission. Eight data lines are used with bit 8 being ignored but electrically terminated. Data is accepted with a STROBE signal from the host, and the receipt of the data is ACKNOWLEDGED by the printer.

The BUSY signal output of the printer is used to indicate the printer's status to the host. The BUSY signal can be set to operate in either of two modes: BUFFER or INTER-CHARACTER BUSY. The timing of the "BUFFER BUSY" and "INTER-CHARACTER BUSY" signals are shown in Figure 2. Basically, in the BUFFER BUSY signal mode of operation BUSY goes true whenever a character is received and the buffer is full. It will stay in the true state until there is enough room in the buffer for another character to be stored, at which time it will go false.

The host should depend upon the ACK signal to slow the data transfer to a rate which the printer is capable of accepting. However, some computer systems do not use the ACK signal and only monitor the BUSY signal. When operated with the P-150 and running efficient machine language software, it is possible for them to overrun the P-150 resulting in missed characters. This condition occurs occasionally in TRS-80's. To avoid this problem a special strap in the P-150 enables the generation of a "CHARACTER BUSY" signal that goes true after the receipt of each character and stays true until the ACK is generated by the printer. This mode allows efficient operation with computers which do not monitor the ACK signal. Refer to Figure 2 for the location of these strap positions.

Figure 2 - BUFFER BUSY and INTER-CHARACTER BUSY

For BUFFER BUSY cut strap between A & B

For HIGH TRUE BUSY connect C & D

For LOW TRUE BUSY connect A & C and cut strap between C & D

If E & F are connected then pin 29 on P4 has +5 volts.

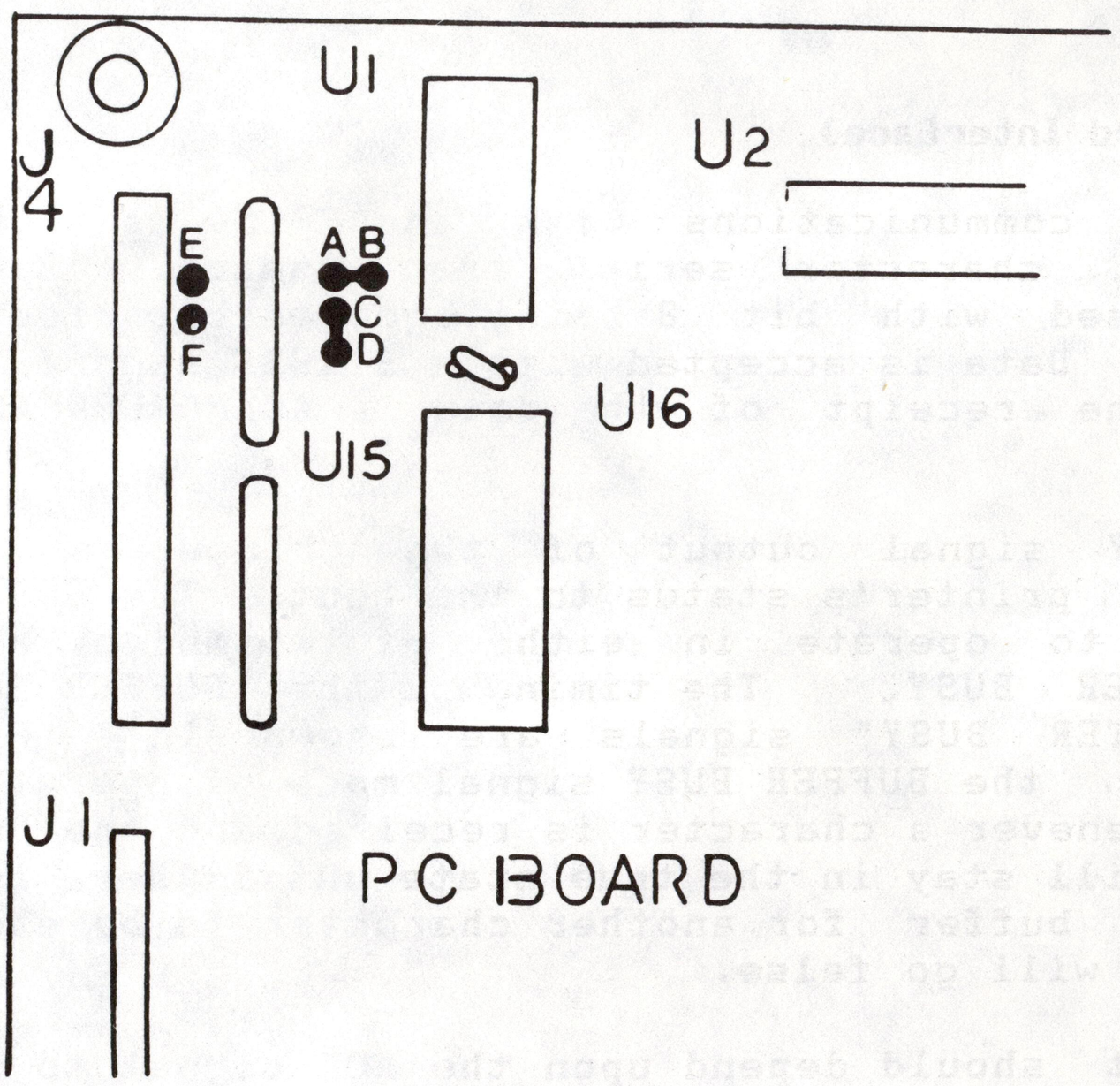
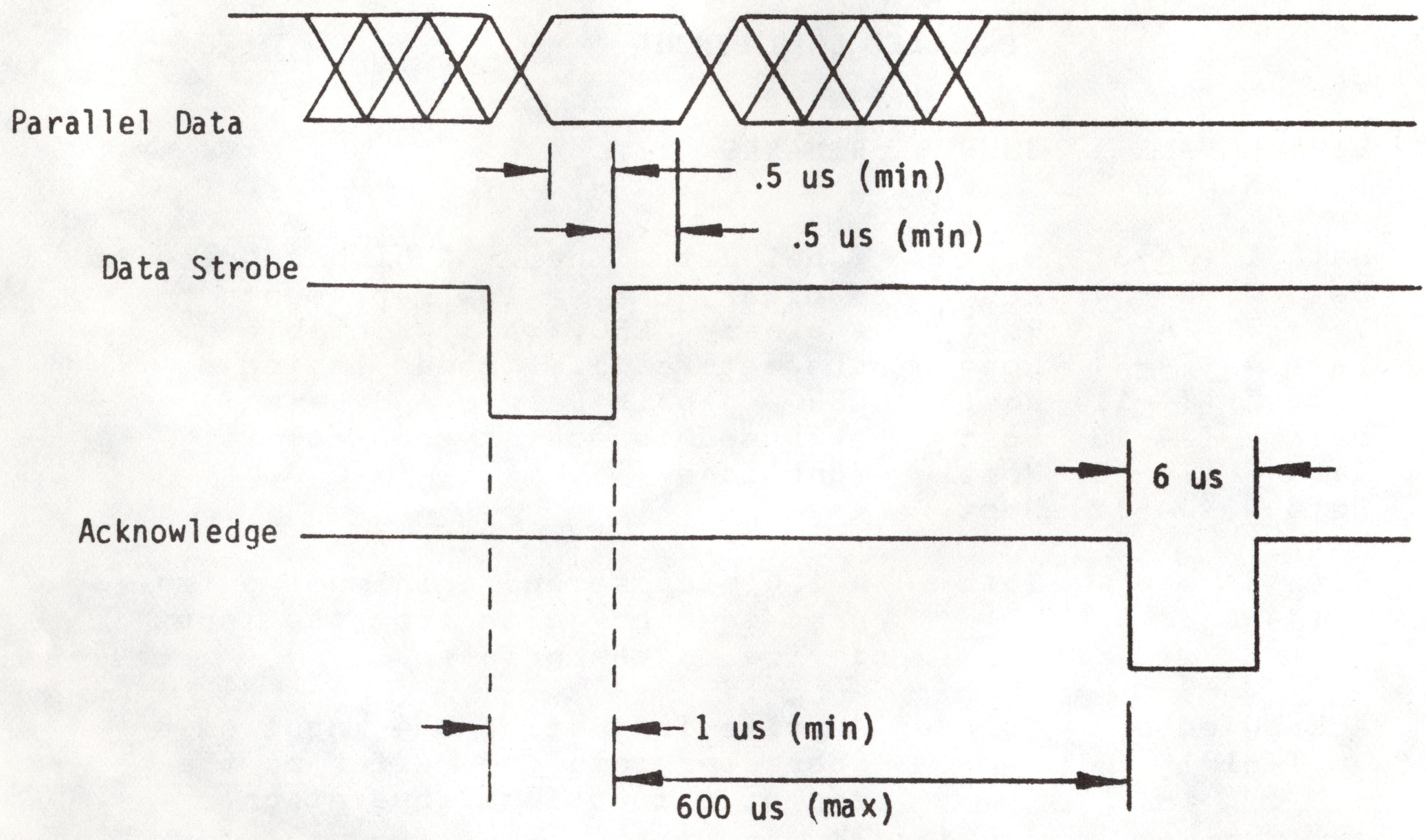
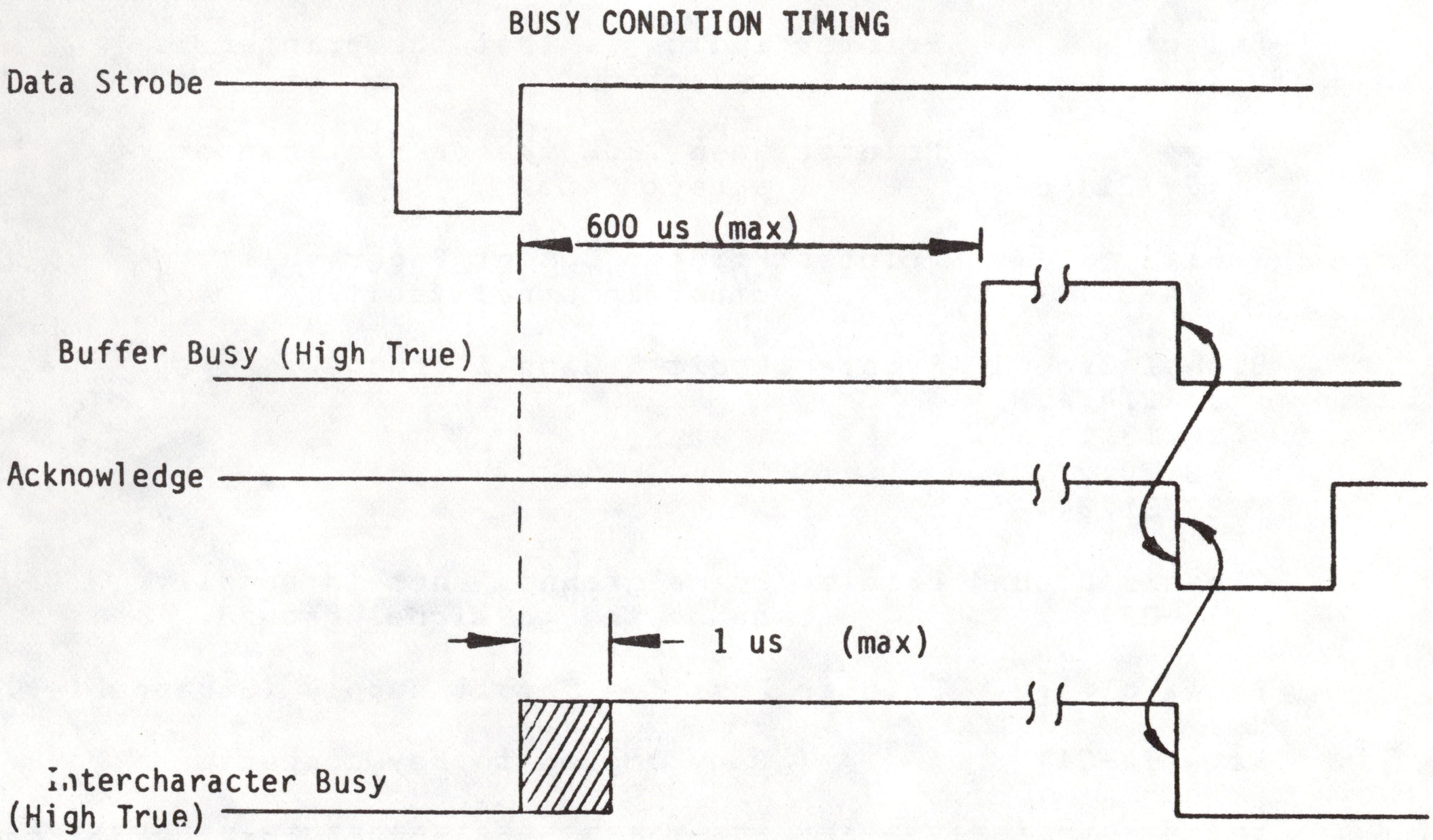


Figure 3 - Timing Relationships, Parallel Data Transfer





PARALLEL DATA PINOUT

SIGNAL NAME & PIN NUMBER	SOURCE	REMARKS
Data 1 (J4-3) Data 2 (J4-5) Data 3 (J4-7) Data 4 (J4-9) Data 5 (J4-11) Data 6 (J4-13) Data 7 (J4-15) Data 8 (J4-17)	Host	Input data lines. A high represents a binary ONE, a low represents a binary ZERO. All printable characters (i.e. codes having a ZERO in both Data 6 and Data 7) are used to specify control functions.
Data Strobe (J4-1)	Host	A 1.0 microsecond (minimum) pulse used to clock data from the input device to the printer.
Acknowledge (J4-19)	Printer	A pulse indicating the input of a character into the buffer or the end of a functional operation.
Input Prime (J4-26)	Host	When a negative pulse is sent on this line, the printer resets.
Select (J4-25)	Printer	Indicates that the printer is selected.
Busy (J4-21)	Printer	When TRUE the printer cannot accept data.
Fault (J4-23)	Printer	Printer Out of Paper or other internal fault.
Signal Ground (J4-2,4,6,8, 10,12,14,16, 18,20,22,24, 27,31,34)	Printer	Logic & Signal Ground.
Chassis Ground (J4-33)	Printer	Frame ground. not internally connected to signal ground.
Plus Voltage	Printer	Positive 5 volt supply (Strappable).
Key (J4-31)		Pin removed to key connector

CENTRONICS CONNECTOR

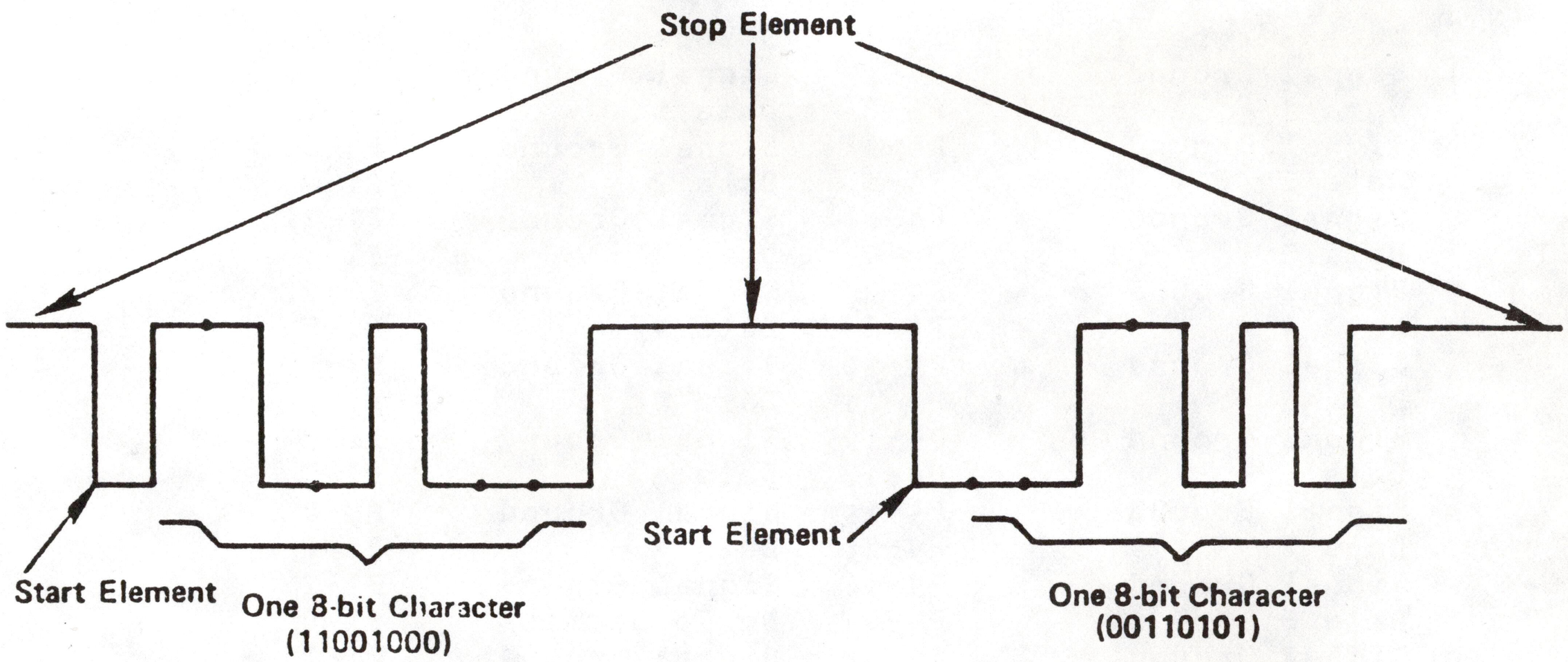
PARALLEL I/O CONNECTOR J4 CENTRONICS CONNECTOR BACK PANEL OPTION

SIGNAL	CONNECTOR/PIN	SIGNAL	CONNECTOR/PIN
Data Strobe	P4-1	Strobe	P1-1
Signal Ground	P4-2	Signal Ground	P1-19
Data 1	P4-3	Data 1	P1-2
Signal Ground	P4-4	Signal Ground	P1-20
Data 2	P4-5	Data 2	P1-3
Signal Ground	P4-6	Signal Ground	P1-21
Data 3	P4-7	Data 3	P1-4
Signal Ground	P4-8	Signal Ground	P1-22
Data 4	P4-9	Data 4	P1-5
Signal Ground	P4-10	Signal Ground	P1-23
Data 5	P4-11	Data 5	P1-6
Signal Ground	P4-12	Signal Ground	P1-24
Data 6	P4-13	Data 6	P1-7
Signal Ground	P4-14	Signal Ground	P1-25
Data 7	P4-15	Data 7	P1-8
Signal Ground	P4-16	Signal Ground	P1-26
Data 8	P4-17	No Connection	P1-9
Signal Ground	P4-18	Signal Ground	P1-27
Acknowledge	P4-19	Acknowledge	P1-10
Signal Ground	P4-20	Signal Ground	P1-28
Busy	P4-21	Busy	P1-11
Signal Ground	P4-22	Signal Ground	P1-29
Paper Out	P4-23	Paper Out	P1-12
Signal Ground	P4-24	Signal Ground	P1-30
Select	P4-25	Select	P1-13
Input Prime	P4-26	No Connection	P1-31
Signal Ground	P4-27	+ or - 0V	P1-14
No Connection	P4-28	No Connection	P1-32
+5V (Strappable)	P4-29	No Connection	P1-15
No Connection	P4-30	+ or - 0V	P1-33
Signal Ground	P4-31	+ or - 0V	P1-16
No Connection	P4-32	No Connection	P1-34
Chassis Ground	P4-33	Chassis Ground	P1-17
No Connection	P4-34	No Connection	P1-35
No wire in cable		+ 5V	P1-18
No wire in cable		No Connection	P1-36

Serial (Optional interface)

Serial data communications with the P-150 printer is asynchronous through either RS232C or Current Loop data lines. The data is sent one bit after another in a serial mode. Each bit is sent at a timed rate and the printer examines the data line at the appropriate times to gather and assemble the data.

FIGURE 4 - Asynchronous Serial Data Transfer



The data is sent in a ten or eleven bit message. In asynchronous transmission, there is no transmitted clock signal. The first bit of this bit string, always a single logic "0" data bit, is termed the start bit. In order for the printer to receive the data bits properly, the host and the printer are both set for a transmission speed, called the baud rate. After the receipt by the printer of the start bit, the printer examines the data line coming from the host at the established baud rate. Depending on the signal level of the line, the printer takes in the data as a "0" or a "1".

The printer examines the data line expecting to receive eight data bits. The highest order bit, bit 8, is ignored. The remaining seven bits are assumed to be the ASCII character that the host wanted transmitted to the printer. The transmissions ends with a logic "1" bit called the "stop bit". The stop bit level is maintained until the next data

character is ready to be transmitted. The minimum time that the stop bit level must be maintained is one bit interval. It is recommended that at least two stop bits be used, that is, the logic "1" level be maintained for at least the time it would normally take for the transmission of two bits. The P-150 will generate two stop bits at 110 Baud and one stop bit at all other speeds.

This increased stop bit interval reduces the chances of errors and facilitates character synchronization. Figure 4 shows a typical asynchronous serial data string.

The next character transmission begins with the start bit of the next character. At this time, the printers internal clock is synchronized to the host clock. The printer then examines the data line at each of the appropriate bit times to capture the next character.

A software generated FIFO buffer is used to average the character rate and will permit transmission of messages at any of the selected baud rates as long as adequate time fill is allowed between successive messages.

BAUD RATE	CHAR/SEC	TIME/CHAR
110	10	100.0 msec
300	30	33.3
600	60	16.7
1200	120	8.3
1800	180	5.6
2400	240	4.2
4800	480	2.1
9600	960	1.05
*19200	1920	.52

* Some protocols that require large block transfers without using a handshake may overflow the buffer at 19.2 KBAUD.

RS232C Operation

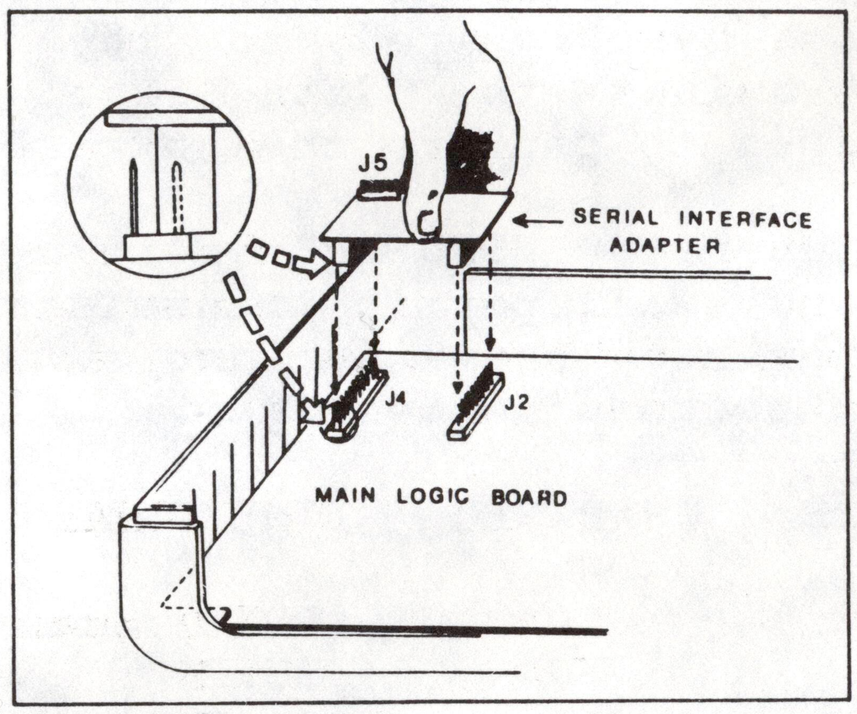
The EIA specified voltages for RS232C are +3 to +25 volts for a "0" or "space" and -3 to -25 volts for a "1" or "mark". The P-150 will operate within these levels.

The Request To Send (RTS) and Data Terminal Ready (DTR) control signals sent from the printer are +10 volts for a SPACE condition, and -10 volts for a MARK condition. These signal levels fall within the RS232C voltage specifications.

SERIAL INTERFACE CARD INSTALLATION

The P-150 Serial Adapter Card is a small printed circuit card that plugs directly onto the main logic board of the P-150. When properly installed, the adapter card allows serial communications to the printer. The adapter card supports RS232C communication directly from the host computer system or through a modem. Receipt of 20 milliamp current loop data is supported by the serial adapter card also.

Figure 5 - Installation of the Serial Adapter



To begin installation, disconnect the AC power from the printer. Place the printer on a clear working surface with the front panel facing you. Remove the top cover from the printer. Locate connector J4 and J2 on the main logic board.

J4 is in the left corner nearest the back of the printer. If a cable is connected to J4, disconnect the cable and remove it.

J2 is located 3 inches to the right of J4. The adapter card is installed on both J4 and J2 connectors of the main logic board.

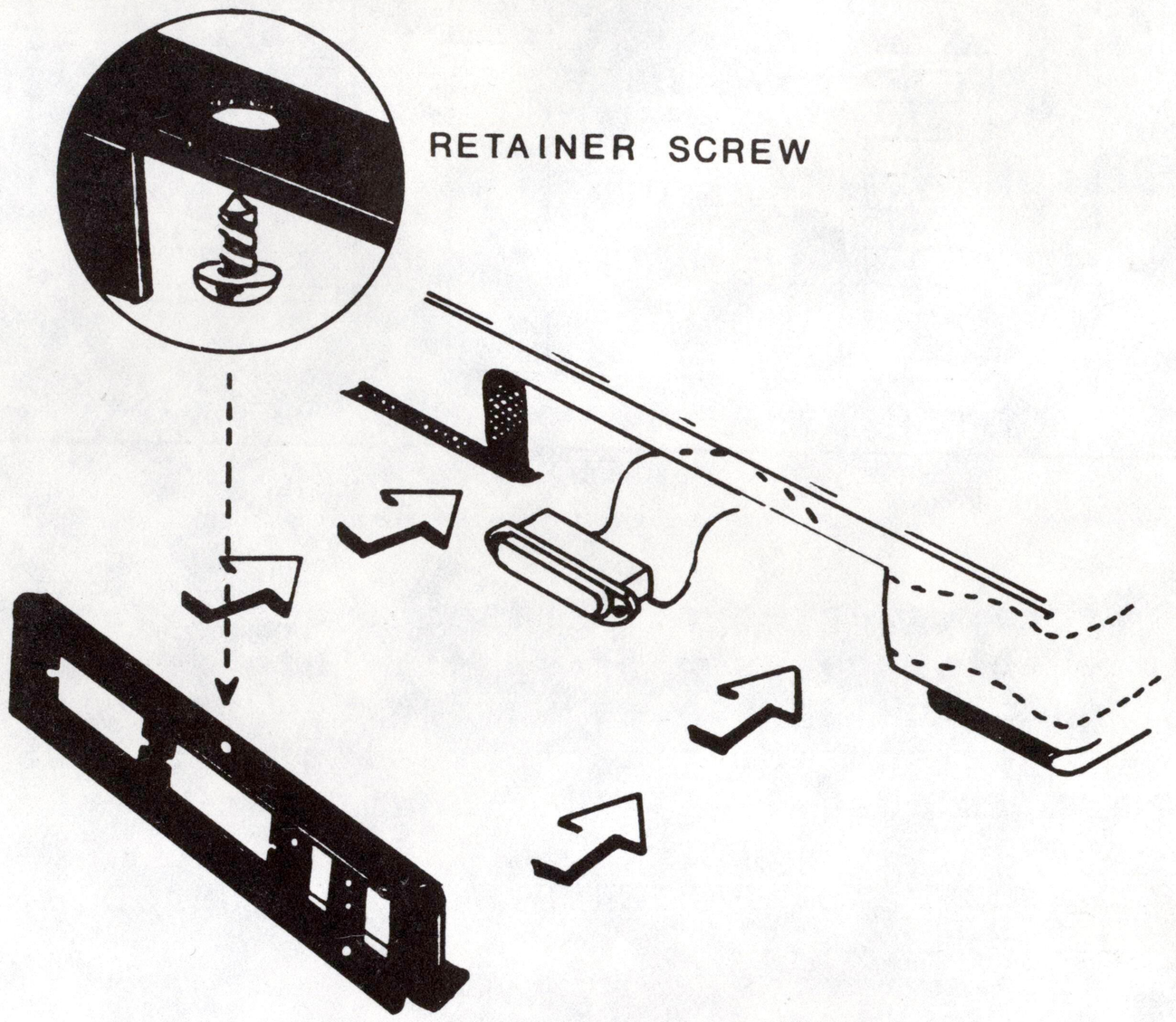
When looking at the adapter card, connector J5 on the adapter card will be toward the back of the printer.

Align the connectors on the bottom of the adapter card with the pins of J4 and J2 on the main logic board as shown in figure 5. Connector J4 on the main logic board has two columns of extruding pins, while J2 has only one column of pins. J4 will have its right column of pins connected to

the adapter card. The left column of pins will not be connected. The adapter has been keyed so that it is not possible to install it incorrectly. When the connectors are aligned, gently seat the adapter card by pushing downward.

On the rear of the printer you will find a connector panel which is retained by a single screw. Remove the screw and slide the connector panel out of the printer. Mount the DB25 connector end of the supplied cable to the panel as shown in figure 6.

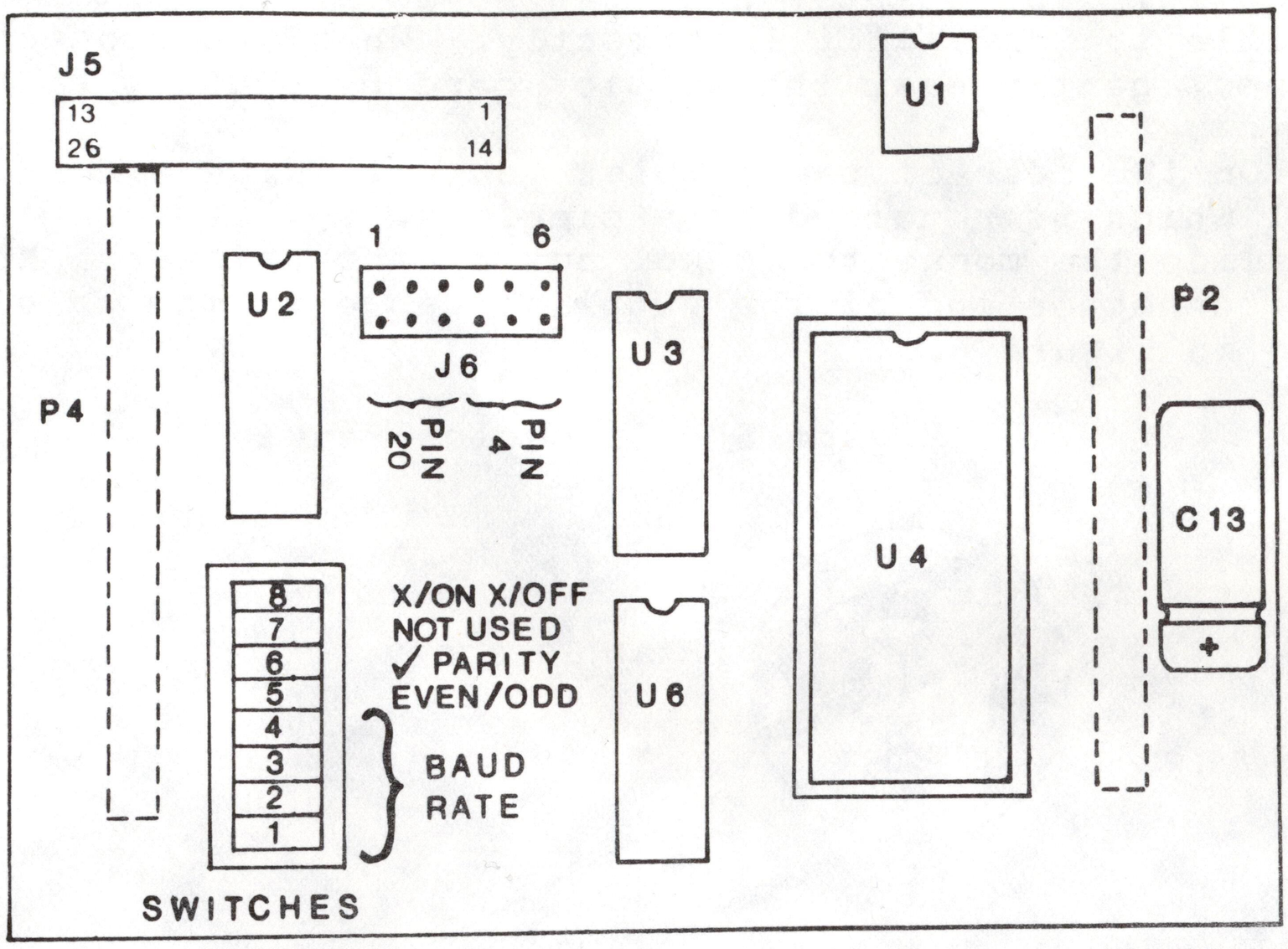
Figure 6 - Connector Panel



Reinstall the rear panel and route the cable to connector J5 on the adapter card. Note that pin #9 on J5 of adapter card has been removed and the corresponding location on the cable has been plugged to prevent installing the connector incorrectly.

When this is complete, the printer may be connected to the host. Bell & Howell has a variety of interconnect cables available to simplify interconnection to the host.

Figure 7 - Serial Interface Card



DIP Switch

The serial adapter card has one eight position DIP switch to enable the user to specify his desired control modes. The following tables summarizes the DIP switch position usages and their factory settings. The switch settings are discussed in additional detail throughout this chapter.

SERIAL ADAPTER DIP SWITCH USAGES

SW	FUNCTION	OFF	ON	FACTORY SET
#1	BAUD RATE	See Table p.21		OFF
#2	BAUD RATE	"	"	OFF
#3	BAUD RATE	"	"	OFF
#4	BAUD RATE	"	"	ON
#5	PARITY	"	"	OFF
#6	PARITY	"	"	OFF
#7	RESERVED FOR FUTURE USE			
#8	X-ON/X-OFF	"	"	ON

Unless otherwise specified, the serial adapter card is shipped from the factory with its jumper blocks on locations 1 and 4 of J6 with XON/XOFF protocol enabled at 9600 baud and parity ignored.

SERIAL PROTOCOLS

The P-150 supports two serial protocols: DTR/BUSY (DATA TERMINAL READY), and X-ON/X-OFF.

DTR/BUSY PROTOCOL

DTR/BUSY is the most common of the communications protocols. In this mode, the host device communicates with the printer over essentially three wires: ground, data, and handshake.

The ground wire, connected to pin 7 on the serial adapter card, provides a logic ground level so that the host and the printer are tied together.

The data wire, connected to pin 3 in the printer, is used by the host to send data to the printer following the format described on the preceding pages.

The third wire, the handshaking wire, may be logically connected to either pin 4 or pin 20 in the printer by means of a jumper block on the serial adapter card. When the P-150 is deselected, out of paper or the buffer is full, pins 4 and 20 will change states indicating that the host should stop sending data. The host is expected to monitor this wire and take appropriate action when so indicated.

The jumper block, J6, (see Figure 7) determines the polarity and pin used for the handshake signal. Connecting the "BUSY" signal to either pin 4 or pin 20, or to both pin 4 and pin 20 are the most common configurations used.

The J6 jumper block selects the operating modes of the DTR/BUSY signal outputs on pin 4 (RTS) and pin 20 (DTR). There are 6 jumper positions in all. Positions 1, 2, and 3 control the signal placed on pin 20 of J5 and positions 4, 5 and 6 control the signal on pin 4 of J5. Please study figure 7 carefully to determine the correct strapping location on J6 for pin 4 (RTS) and pin 20 (DTR).

DTR/BUSY JUMPER SELECTION TABLE

J6 Jumper Position	Result
1	Pin 20 will output a +10V signal when the printer is able to accept data and a -10V when it is not able to accept data (BUSY).
2	Pin 20 logic is inverted from position 1 stated above.
3	Pin 20 will always output a +10V level, i.e., it will not indicate a BUSY condition.
4	Pin 4 will output a +10V signal when the printer is able to accept the data and a -10V signal when it is not able to accept data (BUSY).
5	Pin 4 logic is inverted from position 4 stated above.
6	Pin 4 will output a +10V level requesting to send a protocol character on pin J5-2. This signal does not directly reflect a BUSY status.

WARNING: Do not attempt to connect two different signals to one pin. The printer will not function properly. One jumper block should be placed at position 1, 2, or 3 and another at position 4, 5, or 6. This will select one signal for pin 20 and one signal for pin 4.

SUMMARY

Position	Pin	Signal	SIGNAL LEVEL: OK to Send	Don't Send
1	20	BUSY	+10 volts	-10 volts
2	20	BUSY	-10	+10
3	20	DTR	always +10	
4	4	BUSY	+10	-10
5	4	BUSY	-10	+10
6	4	RTS	Use with X-ON/X-OFF	

The DTR/BUSY protocol is selected by setting switch number 8 on the DIP switch on the serial adapter card to the OFF position.

If your printer has the SoftSwitch keypad option, Item #5 of the status printout will indicate "PROTOCOL IS DTR/BUSY" if switch 8 is in the OFF position.

X-ON/X-OFF PROTOCOL

X-ON/XOFF differs from DTR/BUSY in that a character is sent to the host along the Transmit Data line (Pin 2), rather than having the host monitor the voltage level of a handshake line. The operation of the signals along this line are as follows.

Starting with the printer having an empty buffer and deselected, printing is initiated when the select button on the front panel is depressed. This causes the sending of an X-ON character (the ASCII DC1 character, hex value 11, decimal 17) to the host.

Then the host may send data to the printer. It is stored in the printer's buffer and printed on a first in, first out, fashion. When the amount of data in the printer buffer reaches a point where only 128 characters of buffer remain, an X-OFF character is sent to the host. This character is the ASCII DC3, hex 13, decimal 19. The host will stop sending data. The printer continues printing and removing data from its buffer. When 256 characters of buffer are available, an X-ON character is sent.

The presence of a MemoryMate expansion buffer is automatically compensated for by the software in the P-150. Additional data may be stored in the MemoryMate until it fills at which time the printer will inform the host. Again the X-OFF character is not sent until the last 128 characters in the MemoryMate are reached.

The X-On/X-OFF protocol is selected by placing switch number 8 on the DIP switch on the serial adapter card in the ON position.

If the printer transmitted the DC3 character because of being deselected, the DC1 character will be transmitted as soon as the printer is reselected. If an Out of Paper condition occurs the DC3 character will be transmitted and the printer will stop printing. The printer should be deselected before inserting a new supply of paper. Selection of the protocol is as follows:

SWITCH POSITION	X-ON/X-OFF SELECTION
#8	Off = Disabled On = Enabled

If your printer has the SoftSwitch keypad option, item #5 of the status printout will read "PROTOCOL IS XON/XOFF" if switch #8 is in the ON position.

Setting the Baud Rate

The baud rate for serial data transmission may be set in any of three ways:

- Via the SoftSwitch front panel (PP-150)
- DIP switch settings (P-150)
- Automatic Baud Rate Selection (ABRS) (PP-150 and P-150)

Baud Rate Selection (PP-150)

To set the baud rate from the SoftSwitch front panel, do the following:

1. Deselect the printer.
2. Press #5 on the SoftSwitch keypad.
3. Enter the Baud rate as per table below
4. Press Enter on the SoftSwitch keypad.
5. Select the printer.

The following baud rates may be entered from the keypad with the corresponding codes.

Baud Rate	Key In
50	50
75	75
110	110
135	135
150	150
300	3
600	6
1200	12
1800	18
2400	24
4800	48
7200	72
9600	96
19200	192

If no baud rate is entered (#5 enter), the Auto Baud Rate Selection (ABRS) mode is presumed. Automatic Baud Rate Selection is discussed below.

Baud Rate Selection (P-150)

Positons 1-4 of the DIP switch mounted on the serial adpator card are used to select the desired baud rate. The baud rate setting of the printer must match the baud rate of the sending device. An incorrect baud rate setting will cause the printer to print the '*' character indicated that the incoming data cannot be correctly interpreted.

To set the baud rate using the DIP switches, use the following chart.

DIP SWITCH BAUD RATE CHART

Baud Rate	SW #4	SW #3	SW #2	SW #1
Auto	Off	Off	Off	Off
110	Off	Off	Off	On
300	Off	Off	On	Off
600	Off	Off	On	On
1200	Off	On	Off	Off
1800	Off	On	Off	On
2400	Off	On	On	Off
4800	Off	On	On	On
9600	On	Off	Off	Off
19200	On	Off	Off	On

The other switches on the DIP switch on the serial adapter board have the following functions.

SW#5	--	Parity	Even - Off
			Odd - On
SW#6	--	Parity	Ignore - Off
			Enable - On
SW#7	--	Reserved for Future Use	
SW#8	--	X-On/X-Off	Ignore - Off
			Enable - On

Automatic Baud Rate Selection

If the baud rate of the sending device is not known, the P-150's Auto Baud Rate Selection (ABRS) feature may be employed.

The method of entering the Automatic Baud Rate Selecton mode is determined by the model of the P-150, i.e., a PP-150 (SoftSwitch Front Panel) or a P-150 (DIP switches). With either model the following characteristics indicate that the printer is in ABRS mode. The Paper Advance and TOF front panel switches will be ignored, and the print head will not move into the print area and back to the left margin as occurs during a normal power up sequence.

The P-150 automatically determines the baud rate by receiving a series of SPACE characters, usually sent with approximately one second intervals by striking the space bar on the host or by sending the SPACE characters programmatically. The one second time interval allows the PrintMate's microprocessor an adequate sampling time as it ascertains the baud rate at which the SPACE character was received.

The first character is examined at 19,200 baud. If a valid space character is not received, then the next character will be examined at 9600 baud. Each character is examined at a slower baud rate until a valid space character is detected.

PP-150 (SoftSwitch Keypad)

Try to follow this example on your particular host by preparing it to send output to the Printer. For purposes of this example we will present the conventions used for an Apple II fitted with a serial interface adapter card in slot one attached to a PP-150 with a SoftSwitch keypad.

First, direct output from the keyboard to the printer by typing in PR#1. Then depress the space bar in one second intervals. Each time the bar is depressed, a space is sent to the printer. The incoming data characters will be examined by the printer to determine the baud rate at which the character was sent.

The speaker will give a series of slow beep tones until

the the baud rate is determined. Then the printer will give its normal "command accepted" tone.

In summary to select the baud rate automatically for a PP-150 (SoftSwitch keypad), do the following:

1. Deselect the printer
2. Enter 5 into the SoftSwitch keypad
3. Press Enter
4. Reselect
5. Strike the space bar at one second intervals.

To determine the baud rate at which the printer is set, make a status check by using the following sequence of key strokes on the SoftSwitch front panel.

1. Deselect the printer.
2. Enter 1 into the SoftSwitch keypad.
3. Press Enter.
4. Select the printer.
5. The PP-150 will print the baud rate on its status printout.

When the printer is powered down, the baud rate is stored in its battery powered memory. From then onward the printer will be set to operate at the previously selected baud rate whenever it is powered on.

P-150 (DIP Switches)

To select the baud rate automatically for a P-150 (DIP Switches), follow this sequence.

1. Set the baud rate switches to the off position. (Note all baud rate switches must be set off, do not change any other switch settings.)
2. Strike the space bar at one second intervals.
3. Baud rate is selected when the P-150 aligns its print head by a slight movement to the right and then a return to home position.

Since the P-150 does not feature a battery powered memory backup, the previously established baud rate is lost at power down. If the Baud Rate DIP switches are kept in the off positions, then you must use this sequence each time you power up your printer.

However, if you can determine what the baud rate between your host and the is, then it is advised that you set the baud rate in the DIP switches accordingly and thereby avoid this manual method of determining baud rate during the power on sequence. Please reference the baud rate chart for the proper settings listed above.

Serial Adapter Card Parity

The parity bit is used as a method of verifying that the character just sent from the host was received correctly. The printer is expecting to receive one start bit, 7 data bits, one parity bit and at least one stop bit. The parity setting between the host and the P-150 must match. If the parity bit does not match the setting selected in the DIP swtiches, the P-150 will print the '*' character indicating the error. Parity selection is as follows:

Switch Position

#5	Off = Parity Even
	On = Parity Odd
#6	Off = Parity Ignored
	On = Parity Enabled

If the host is sending 7 data bits without a parity bit, switch position #6 should be set to Off and the host should be made to send 2 stop bits.

The printer cannot be configured to receive 8 data bits with parity. If the host sends 8 data bits with parity, the will print '*' to indicate an overflow. Set DIP switch position #6 to Off and the parity bit will be ignored. In any case bit 8 is always ignored by the P-150.

Interface Signals

(DB25 Pin Identification)

PIN 1 Case Ground (GND)
A protective ground connected to the grounding connections of the AC power cord. This signal is not internally connected to the signal ground.

PIN 2 Transmit Data (TD)
An RS232C output which is used to send protocol characters from the printer to the host.

PIN 3 Receive Data (RD)
An RS232C input from which data is received by the printer.

PIN 4 Request to Send (RTS)
An RS232C output which is used to control data flow from the host.

PIN 5 Clear to Send (CTS)
An RS232C input which inhibits transmission of protocol characters to the host when held in a false state (-10V). If left unterminated, this signal defaults to true.

PIN 6 Data Set Ready (DSR)
An RS232C input which causes a status indication on transition. (Currently ignored by the P-150.)

PIN 7 Signal Ground (S.GND)
A common reference for all RS232C signals.

PIN 8 Data Carrier Detect (DCD)
An RS232C input which if held false (-10V) disables receipt of serial data. If left unterminated, this signal defaults to true.

PIN 11 Current Loop Positive (CL+)
A non RS232C input requiring 20 milliamps of current to establish a mark state.

PIN 20 Data Terminal Ready (DTR)
An RS232C output used to control data flow from the host (See operaton below).

PIN 25 Current Loop Negative (CL-)
A non RS232C signal which is the return path for the signal on pin 11.

Normally, only three signal connections are necessary for accurate RS232C data flow: Signal Ground Pin 7, Receive Data Pin 3, and Handshake, either RTS Pin 4 or DTR Pin 20.

Current Loop Operation

Current Loop operation is a variation of the serial data transmission mode. Instead of being a voltage driven system, it is current driven. If current is flowing at a 20 milliamp rate, the data bit is a logic "1" (mark). If no current is flowing, the data bit is a logic "0" (space).

The printer is not capable of transmitting protocol characters in the Current Loop mode. Therefore the baud rate must be kept below 1200 baud. If the baud rate is greater than 1200 baud then either pin 4 or pin 20 on the DB25 connector must be used to control data flow.

The voltage levels of non Current Loop interfaces may damage components in the P-150. For Current Loop operation, the current must further be limited to 20 ma by the host system or the input circuitry may be damaged.

The P-150 can only receive Current Loop signals and cannot transmit a Current Loop signal. Therefore any line protocol that requires the transmission of characters by the printer will not operate in the Current Loop mode.

IEEE 488 (Optional Interface)

The P-150 printer contains a Centronics type parallel interface that is not compatible with the IEEE 488 bus used by various computer systems such as the Commodore PET computer system. If the P-150 printer is to be used with the IEEE 488 bus, an IEEE to Centronics adapter card option must be used. This adapter card must provide for the handshaking, address recognition and impedance levels required by the IEEE 488 bus. Refer to the section on DTR/BUSY in this chapter for an explanation of voltage levels and other germane information.

IEEE CENTRONICS Card Cable Assembly

This card is designed to mount internally in the P-150 casework in the same manner as the Serial Adapter. It has a 34 pin female connector mounted on the PC card assembly that mates to the parallel I/O connector of the P-150 (J4). The

input to the card is through a ribbon cable that is terminated in a standard IEEE 488 connector (TE Ansley PN 609-24-M) that mounts on the external connector panel. This connector will connect directly to the IEEE peripheral cables.

IEEE 488 Peripheral Addressing

The IEEE 488 bus interface is a broadcast system that sends out address information to all peripherals when it wishes to conduct an I/O operation. The adapter cards are shipped configured with an address of 4. For example, the standard PET procedure when PET employes the IEEE 488 bus interface, is to assign the printer an address of 4.

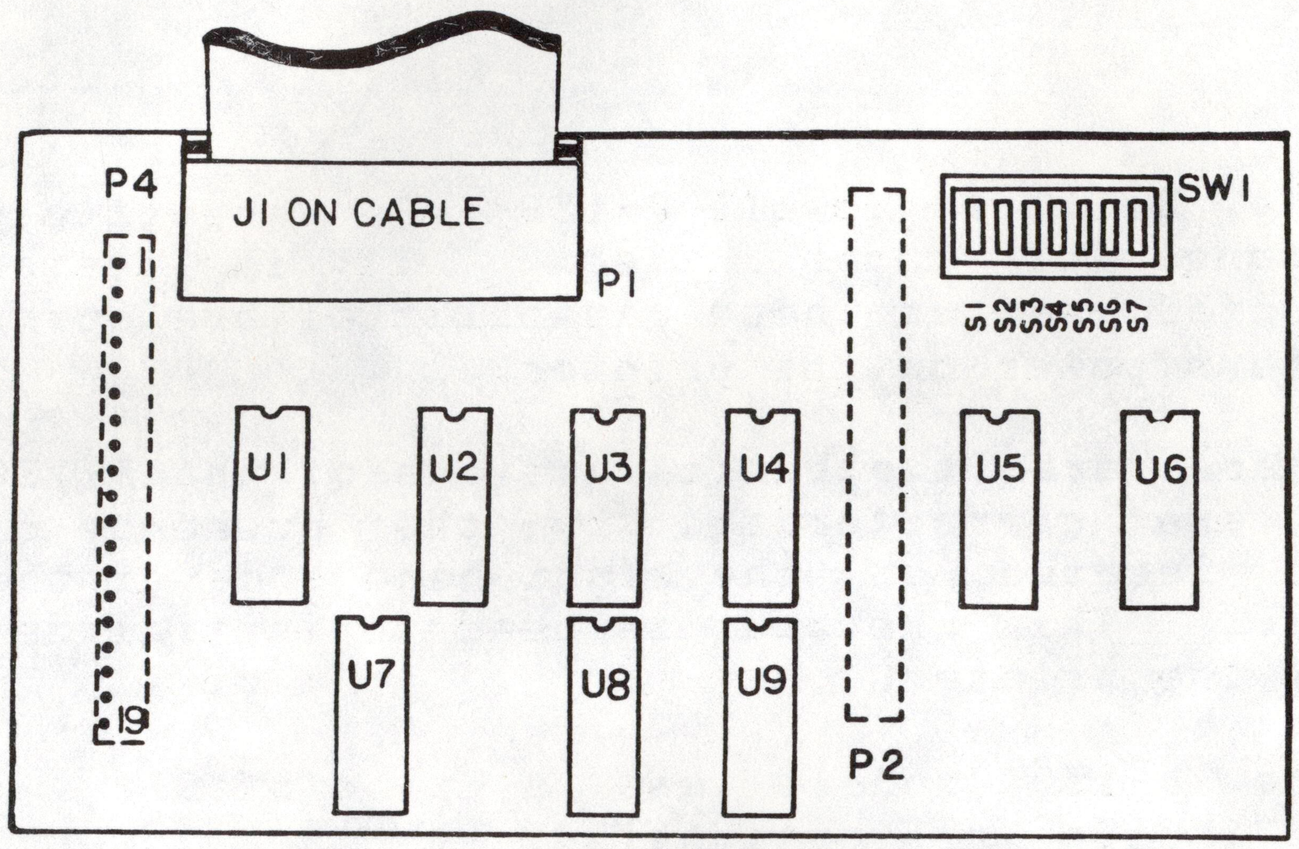
If for some reason you wish to operate with a different address, you may do so by setting the address differently on the adapter card. The address is set by a series of switches. They are located on the component side of the card. Five switch positions, numbered 1 through 5 establish the binary address. The switches are interpreted as binary digits with switch #1 being the low order bit and switch #5 as the high order bit. The setting of a switch to the ON position corresponds to a binary "1" and the absence of a strap is a binary "0". Switch position #3 represents a binary address 4. Address 31 is reserved for use by the IEEE interface itself.

IEEE ADAPTER CARD ADDRESSING

DEVICE ADDRESS	SWITCH #5	#4	#3	#2	#1
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
" " "	"	"	"	"	"
" " "	"	"	"	"	"
etc.	etc.				

If you use the IEEE 488 adapter card it is strongly advised that you closely read the relevant technical data associated with the host device.

Figure 8



IEEE ADAPTER

INITIALIZATION

The Bell & Howell P-150 is a versatile printer with a wide range of capabilities. It is designed so that a preselected set of these capabilities are operative when you first turn power on the printer.

There are two basic versions of the P-150. The PP-150 models are characterized by the presence of a SoftSwitch keypad, located on the right hand side of the front of the printer. This keypad is used to initialize the operating mode of the printer.

The P-150 models use a pair of DIP switches located either inside or optionally at the lower rear of the printer. In either case the DIP switch settings are identical and serve to establish the mode in which the printer initializes when the printer powers up.

The first part of this discussion will describe the method of setting DIP Switches on the P-150 models. During this discussion SW1 refers to DIP Switch-1 and SW2 refers to DIP Switch-2.

The second part of the discussion will describe mode setting with the PP-150 models which have the SoftSwitch keypad.

Model P-150's Without SoftSwitch Keypad

DIP SWITCH SETTINGS

FEATURE NAME	SWITCH	REMARKS
Select Character Set	SW1-1 SW1-2	Selects one of the four language character sets available in the printer.

Language Font SW1-1 SW1-2

US ASCII	OFF	OFF
French	OFF	ON
German	ON	OFF
British	ON	ON

Auto Line Feed Select	SW1-3	This switch allows the automatic insertion of a Line Feed (LF) after the receipt of a Carriage Return (CR). If the switch is ON, a CR will terminate the print line and advance the paper one line. If it is OFF, a CR will terminate the print line but will NOT space the paper.
NOT USED	SW1-4	FOR FUTURE USE
NOT USED	SW1-5	FOR FUTURE USE
NOT USED	SW1-6	FOR FUTURE USE
NOT USED	SW1-7	FOR FUTURE USE
RAM SUPPLY	SW1-8	MUST BE TURNED ON

FEATURE NAME	SWITCH	REMARKS
Form Length Select	SW2-1 SW2-2 SW2-3 SW2-4	These switches allow the selection of one of sixteen form lengths as shown in the following table:

Form Length	SW2 -4	SW2 -3	SW2 -2	SW2 -1
0.0"	ON	ON	ON	ON
3.0"	ON	ON	ON	OFF
3.5"	ON	ON	OFF	ON
4.0"	ON	ON	OFF	OFF
4.5"	ON	OFF	ON	ON
5.0"	ON	OFF	ON	OFF
5.5"	ON	OFF	OFF	ON
6.0"	ON	OFF	OFF	OFF
7.0"	OFF	ON	ON	ON
8.0"	OFF	ON	ON	OFF
8.5"	OFF	ON	OFF	ON
9.5"	OFF	ON	OFF	OFF
10.0"	OFF	OFF	ON	ON
11.0"	OFF	OFF	ON	OFF
12.0"	OFF	OFF	OFF	ON
14.0"	OFF	OFF	OFF	OFF

The printer powers up with the form length selected by the switches, but the switches may be overridden by an Escape Sequence Command sent to the printer under program control.

Automatic Perforation Skip	SW2-5	This switch allows the selection of the automatic Skip Over Perforation feature. When it is ON, the printer will skip one inch each time the paper is advanced the selected form length. When this switch is OFF, the printer will print over the entire length of the form under program control. NOTE: If the selected Form Length is 0", then the Automatic Perforation Skip switch should be off or the function should be disabled under program control.

Feature Name	Switch	Remarks
Line Spacing Select	SW2-6	This switch selects the line spacing. When it is ON, the printer prints 8 vertical lines per inch. When it is OFF, it will space lines at 6 vertical lines per inch.
Character Density Select	SW2-7 SW2-8	These switches set the desired horizontal printing densities as follows:

Char. Line	Font	Densities: (CPI*)	(DPI**)	SW2 7	SW2 8
136	7X9	10	50	ON	ON
163	7X9	12	60	ON	OFF
136	11X9	10	80	OFF	ON
231	7X9	17	85	OFF	OFF

* CPI -- Characters Per Inch
** DPI -- Dots Per Inch (Graphics)

The printer powers up in the mode selected by these switches. The mode may be overridden, by sending an Escape Command Sequence under program control.

On P-150 model printers without the SoftSwitch keypad, the following conditions are established during initialization:

Horizontal Tabs -- Every eighth position, beginning with column 9.
Vertical Tabs -- All cleared
Character Set -- US ASCII

PP-150's with SoftSwitch Keypad

The PP-150's employ a keypad and a musical response to enter mode settings. When entries are made into the pad by a key in sequence, the printer responds musically informing the operator if the key in was accepted or not accepted. These entries are then retained by the printer for future use. A battery keeps the settings alive for extended periods even when the power is turned off.

There are twelve keys numbered "0" through "9," "." & "▲" The keys are defined as follows:

0 -- Clear Horizontal Tab
1 -- Print Initialization Status
2 -- Select Alternate Print Font

3 -- Set Form Length
4 -- Set Line Feed on Carriage Return
5 -- Set Serial Baud Rate

6 -- Set Characters Per Inch
7 -- Set Vertical Tab Stops
8 -- Set 6 or 8 lines per inch

9 -- Set Auto Perforation Skip
▲ -- Enter Data Into Printer
. -- Use As Decimal Point and to Set Horizontal Tab Stops

Before entering any mode change setting the printer must be deselected (Select Switch in the released position). When an entry is made and if the entry is accepted by the printer, a three note musical acceptance tone is generated. If the entry is not accepted, a series of three rapid single tone notes are generated.

KEYPAD EXAMPLES

These discussions and examples will demonstrate the sequence of entry to input mode changes through the keypad.

To set 6 or 8 lines per inch.

1. Depress switch # (8)
2. Depress 6 or 8
3. Depress Enter (▲)

FORM LENGTH SELECT

Assume that you desire to set the form length to 11.5 inches.

1. Depress the Form Length Select (3)
2. Enter the form length (11.5)
3. Depress the Enter key (▲)
   Music

The Forms Lengths acceptable for entry from the front panel include 0" and then any length from 1.5" to 31" in 1/2" increments. A 1/2" increment entry is made using the "." key as a decimal point.

CHARACTER DENSITY

Print densities are stated in characters per horizontal inch. Five character densities may be entered through the Softswitch Status keypad. The following table shows the Characters Per Inch (CPI) and its corresponding Density Per Inch (DPI).

DPI	CPI	
50	10	
60	12	
80	10	(Serif Font)
75	15	
85	17	

As an example to set a character density of 12 characters per inch via the front panel is accomplished by the following sequence:

6 -- Set Character Density Command
12 -- Set 12 Characters Per Inch
▲ -- Enter
Music

Setting Serif Font is considered a special case and it is accomplished by the following sequence:

6 -- Set Character Density Command
▲ -- Enter
Music

HORIZONTAL TAB

From the front panel keypad, tabs are set using the following sequence.

. -- Set Horizontal Tab Command
n -- Column at which to set a tab
▲ -- Enter
Music

Where n must be between 1 and 231. An out of bounds entry is signified by an error tone. The column entries do not need to be in sequence.

To clear a single tab:

0 -- Clear Horizontal Tab Command
n -- Column at which to clear a tab
▲ -- Enter
Music

To clear all tabs enter:

0 -- Clear All Tabs
-- Enter
Music

On P-150 model printers without the SoftSwitch keypad installed, the power up default tab settings are at every eighth position, beginning with column 9.

VERTICAL TAB

From the front panel keypad, vertical tabs may be set using the following sequence:

7 -- Set Vertical Tab
n -- Line at which to set a tab stop
▲ -- Enter
Music

"n" may be any value between 1 and 248. Vertical tabs may be set from the front panel in any sequence. Up to 8 Vertical tabs may be set at once.

To remove all vertical tabs which have been set, enter the following sequence:

7 -- Set Vertical Tab
▲ -- Enter
Music

Vertical tabs cannot be removed individually, but they can be set individually.

SKIP OVER PERFORATION

From the front panel keypad, the following sequence is used to enable Skip Over Perforation:

9 -- Skip Over Perforation
1 -- Enable Skip
▲ -- Enter
Music

From the front panel keypad, the following sequence is used to disable Skip Over Perforation:

9 -- Skip Over Perforation
0 -- Disable Skip
▲ -- Enter
Music

Any entry but "0" or "1" results in an error tone when Enter is pressed.

CHARACTER SETS

The P-150 contains four language character sets. These character sets have essentially the same characters but with minor changes. For instance the major change in the British set is that it has a Pound sign rather than a Dollar sign.

The character sets are not selectable under program control, but only via DIP switches or from the front panel keypad. The sequence to change the character set from the front panel is as follows:

2 -- Select Character Set
n -- Specify Character Set
▲ -- Enter
Music

Where the number n may be any one of the following:

0 -- United States ASCII
1 -- French
2 -- German
3 -- British
4 -- Down Line Loaded Font

If no font has been down line loaded, the entry of a 4 in this sequence will generate an error musical tone.

The following table shows the hexidecimal code for the characters that change with the various language character sets.

CODE	USA	FRANCE	GERMANY	ENGLAND
(23) H	#	#	#	£
(40) H	@	à	§	@
(5B) H	(	°	Ä	(
(5C) H	\	Ç	Ö	\
(5D) H	)	§	Ü	)
(7B) H	{	é	ä	{
(7C) H	;	ù	ö	;
(7D) H	}	è	ü	}
(7E) H	~	¨	ß	~

AUTOMATIC LINE FEED ON CARRIAGE RETURN

The following examples show how to turn on and turn off the Automatic Line Feed on Carriage Return.

To turn on Auto LF on CR.

4 -- Select Auto LF on CR
1 -- Set Auto LF on CR
▲ -- Enter
Music

To turn off Auto LF on CR.

4 -- Select Auto LF on CR
0 -- Set Off Auto LF on CR
▲ -- Enter
Music

PRINT INITIALIZATION STATUS

One of the most salient and useful features of the PP-150's SoftSwitch Status keypad is the ability to print the PP-150's present mode status. The status can only be printed if you have the SoftSwitch Status Keypad. Here is an example showing how to enter a request for a printed status and an example printout.

1 -- Select Status
▲ -- Enter
Music

Engage the Select Switch to print the status.

Status cannot be printed unless the PP-150's buffer is empty. If an attempt is made to print status with data in the buffer, an error tone will be generated.

Here is an example of a mode status printout. The printout indicates the following printer status:

1. The result of the printer diagnostic self test
2. The selected character font is USA ASCII
3. The selected form length is 11 inches.
4. The Auto LF upon receipt of CR is off.
5. The parallel interface is installed.
   (Optional Serial I/F is not installed.)
6. The selected character density is 17 CPI.
7. Vertical tabs are set at lines 5, 12, 25.
8. The line density selected is 6 LPI.
9. The Auto Perforation Skip feature is not selected.

. No status meaning. Printed only for reference.
0 No status meaning. Printed only for reference.
x Denotes a horizontal tab at the position indicated.

```
KEY:     STATUS:
1-   MPI 150 STATUS CHECK
     ROM CHECKSUM IS $419E
     RAM CHECK OK
2-   CHARACTER FONT IS USA ASCII
3-   FORM LENGTH IS 11
4-   AUTO CARRIAGE RETURN IS OFF
5-   INTERFACE IS PARALLEL
6-   CHARACTERS PER INCH IS 17
7-   VERTICAL TABS AT LINES 5,12,25
8-   LINES PER INCH IS 6
9-   PERFORATION SKIP IS OFF
.-   SET HORIZONTAL TABS
0-   CLEAR HORIZONTAL TABS

12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901
                X           X   X           X
```

PROGRAMMING

PROGRAMMING CONSIDERATIONS

This chapter will introduce you to the vast programming capabilities of the P-150. Numerous examples and tables are provided to assist you as you manipulate the P-150 programmatically.

In many instances the P-150 will receive standard print data from its host through common print commands such as: PRINT, LIST or LLIST with an accompanying print argument list. The particular command employed varies from one vendor to another. Obviously, it is not necessary for a programmer to pursue additional control of the printed output if he only uses these common print commands.

The P-150, however, offers numerous printing and graphic features which are not found in other printers. The programmer may embellish his printed page as he sees fit by using the P-150's many capabilities. Several excellent software packages which utilize these capabilities are available from Bell & Howell for use on numerous computer systems.

The Bell & Howell P-150 has been designed to be extremely simple to use. At the same time the printer will satisfy the most demanding applications where sophisticated control techniques allow for a maximum amount of printing with a minimum of programmer intervention.

As described in the Initialization chapter, the P-150 powers up in a mode established by the settings of either its SoftSwitch Status Keypad or its DIP switches. This operational mode may be changed through the use of control codes sent to the printer by the host. When such a mode is changed under software control, the new mode will remain in effect until changed again by software or until the printer is powered down. A power failure may cause the printer to lose its buffer of data and to repower up in its native mode. The SoftSwitch Status Keypad does NOT lose its settings, however, and they are retained whenever power is turned off, regardless of the circumstances.

The P-150 operates in a fully buffered mode. Data is sent to the printer as it is generated and it is subject to the buffer's limitations. Buffered data may be expanded by the addition of the MemoryMate.

The P-150 prints only bidirectionally; print commands from programs written for earlier Bell & Howell printers that request unidirectional print mode are ignored.

Commands are sent to the printer and are handled in their logical sequence. For instance, if the printer's buffer has received ten lines of data and then receives a command to change its density from 136 columns to 231 columns, the change takes place only after the ten previously buffered lines of data are printed. In general this is accomplished by simply storing command information in the buffer along with the printable data characters. When the printable data characters are printed, the command information is next in line and is then executed.

PRINT LINE TERMINATION

The P-150 operates as a line printer. Data is sent to the printer in the order in which it is to be printed. At the end of a line of data, the printer is told to print that data with any of several commands.

Lines of data are terminated by a Carriage Return, by a Line Feed, or by a Carriage Return and Line Feed pair sequence. The status of the Auto Line Feed on Carriage Return determines if a Line Feed is to be automatically performed upon the receipt of a Carriage Return. If the status is ON, a Line Feed is not assumed to follow every Carriage Return, and is inserted into the data stream. If the status is OFF, a Carriage Return will terminate a line and force printing, but the paper will not be advanced until a Line Feed is received by the printer.

The printer will terminate a line of data which equals or exceeds the current horizontal line length. For example, if the initialization mode sets the print line length at 136 horizontal characters and more thatn 136 contiguous data characters are received, the P-150 will print the first 136 characters, generate a LF/CR and hold the remaining data characters until a line termination character is received.

In addition to these normal termination modes, the printer will terminate a print line and will set the column count to zero, but will NOT advance paper when the following commands are received:

1. Any Print Density Change, i.e. to change the printer mode from 136 to 231 columns. If a density change is made within a print line, the column position indicator is updated to reflect the value of the column count that represents the head position of the new density which is zero.

2. Any Form Length Change, e.g., if you change the form length from 10" to 11".

3. A Skip Over Perf Mode Change, i.e., enabling or disabling the automatic Skip Over Perf feature.

4. Carriage Return (CR) and Graphics mode operation perform their respective functions and DO reset the column position counter in the printer to zero.

The following commands do not force the termination of a line of data. When these commands are sent, they become effective in their logical sequence. For example, if there are ten lines of data stored in the printer for printing they will be printed before these commands go into effect. Example: If a portion of a line of data is to be underlined, the begin and end underline commands are positioned around that data.

1. An Elongation Change, i.e., changing the printer from the normal character mode to elongated character mode.

2. A Vertical Spacing Change, i.e., a change from 6 lines per vertical inch to 8 lines per vertical inch.

3. A Begin Underlining command, i.e., begin underling with the next data character.

4. An End Underlining command, i.e., end underlining after the last data character printed.

The following commands do not affect the column position counter.

1. The Line Feed (LF) command causes the printer to advance paper one line and DOES NOT reset the column position counter in the printer.

2. The Vertical Tab (VT) command causes the printer to space paper to the next vertical tab posision set by a previously issued Set Vertical Tab command.

3. A Form Feed command terminates the data line and advances to the next Top Of Form.

ASCII INTERNAL CODE

The P-150 uses the 96 character ASCII format (American Standard Code for Information Interchange) as its internal code. ASCII defines which bit patterns will represent which alphabetic, numeric or special character. Many of the special characters, especially those from 0 to 32 (base 10), represent single control characters that are recognized and implemented in some fashion by most data processing manufacturers.

The P-150 recognizes some of these control characters itself, and when it receives them from the host, it produces an appropriate response from the printer as defined in the various sections which follow in this chapter. Refer to the ASCII code chart in the appendices of this manual.

Other internal codes may be specified. The P-150 comes with 4 standard predefined character sets: 1, US ASCII, 2) French, 3) German, and 4) British. Additionally it allows the user to define his own character set through the use of the down line loadable font feature, which is discussed later in this chapter.

PRINT COMMAND FORMATS

ASCII commands issued to the P-150 are staged in either single character format or in two character format. The single character commands are: Carriage Return, Line Feed, Form Feed, Begin Underlining, End Underlining, Backspace, Horizontal Tab, Vertical Tab and the Graphics Mode Terminator.

The two character sequence begins with the ESCape character and consists of the ESCape character followed immediately by the actual command character. Because the possible combination of two character commands from the entire 96 character ASCII set is so large, the ESCape character is the first character of all two character commands. This readily identifies the character string as a command to the P-150, and not as a string of data which is to be printed.

PROGRAMMING THE P-150

Regardless of the model P-150 you have, all models possess identical software capabilities and printing characteristics. Control over the printer can be maintained in three ways:

1. SoftSwitch Keypad Commands
2. Programmatic Control
3. Keyboard Programming

SoftSwitch Keypad Commands

The chapter on Initialization discusses control of the printer via the SoftSwitch keypad. Please refer to it for an explanation of how to enter commands through the SoftSwitch keypad.

Programmatic Control

As mentioned above, the commands sent to the P-150 are usually two characters long. The first character is typically an ASCII Escape character. This character is a hexidecimal 1B, or a decimal 27. The actual command is the first character following the ESCape character.

Look for a moment at the ASCII code chart included in the appendicies to this manual. This chart defines the bit patterns used by virtually all personal computers. The capital letter "S" would serve as a good place to begin discussing this chart. The character is located at the junction of column 5 and row 3. These columns and rows are defined in hexidecimal and refer to the bit patterns that specify this character. Thus the hexidecimal code that causes the P-150 to print an "S" is "53". This corresponds to the bit pattern "101 0011". You will also note that in the box with the "S" are two numbers "83" and "123". Also note that the upper left hand corner of the box is darkened.

The character "S" can be referred to by any of these numbers:

"S" is "101 0011" in binary, base 2 arithmetic
"S" is "53" in hexidecimal, base 16 arithmetic
"S" is "83" in decimal, base 10 arithmetic
"S" is "123" in octal, base 8 arithmetic

In many BASIC languages, the LPRINT command can be used to send characters to the P-150. The following BASIC command would cause the P-150 to print an "S"

LPRINT "S"

When this command is executed, the binary pattern "101 0011"is sent to the P-150.

Likewise most BASICs have a function called CHR$. This function (Refer to your BASIC manual for more information on just how to use it.) converts a decimal number to the binary pattern. Therefore the following two BASIC statments would be functionally equivalent.

LPRINT "S"

LPRINT CHR$(83)

Either of these statements will do the same thing, make the P-150 print a capital "S".

The other two ways of specifying an "S" binary and octal, are not commonly used with personal computers.

Finally, the shaded corner says that "S" can also be used as a command. Specifically an "S" when preceded by an ESC character will cause the P-150 to begin printing at eight lines per inch.

Again refer to the ASCII code chart. The left two columns are the ASCII defined commands. The only real standards for use with printers are Carriage Return (0D hexidecimal); Line Feed (0A) hexidecimal) and the Escape (1B). The Escape character can be sent to the printer with a CHR$ function just as was used above (LPRINT CHR$(27)). These two rows are the ASCII command characters. The Bell & Howell P-150 uses these commands to program the computer.

Virtually all personal computers allow the sending of the ESCape character to the printer. Some personal computers however, do not allow the sending of any other commands. As such, Bell & Howell has defined alternate commands.

The "S" mentioned earlier is such an alternate command. The command which "S" represents is "Set 8 Lines Per Inch." For "S" to be a command, it must be preceded by an ESCape.

To send a "Set 8 Lines Per Inch" command to the printer, either of the two following BASIC statements could be used.

```
LPRINT CHR$(27)+"S"

LPRINT CHR$(27)+CHR$(83)
```

As mentioned, the "S" is an alternate command. Look at the ASCII chart again. The "S" is located at the intersection of column 5 with row 3 and has a hexidecimal value of "53". By removing the top bit, b7, the hexidecimal value would be converted to "13". "13" is in the first two columns and are ASCII defined command codes. The "S" is a printable character. Bell & Howell has established that either the commands from the first two rows or rows 4 and 5 can be used as commands. And further that the relative position of characters within the two rows are assigned to the same relative positions. Thus the following command also sets the printer to printing 8 lines per inch. Note that "13" hex corresponds to "19" decimal.

```
LPRINT CHR$(27)+CHR$(19)
```

If your personal computer allows the sending of characters from the two command columns, 0 and 1, it is suggested that you use these commands. If your computer will not allow the issuing of such commands, then you may use the printable characters.

Keyboard Programming

It is possible to program the P-150 from the keyboard of most personal computers.

First, to send a command to the P-150, one must direct the command output to the P-150. In the case of an Apple II the command PR#1 is entered and any subsequent output, command or data, is directed to the P-150.

Second, special consideration must be given to entering the ESCape character via the keyboard. One cannot merely type an ESCape character from the keyboard on some systems and pass it directly to the P-150.

To make it easy to send an ESCape character to the P-150 from an Apple computer Bell & Howell has added an additional function to the Auto/Plot control card usually supplied in Bell & Howell's AP-PAK. Using the Bell & Howell Auto/Plot card on an Apple computer an ESCape character is generated by typing CTRL and an "E". On most other

microcomputers the ESCape character is generated by typing a CTRL and a "[", (left bracket). You must determine what the proper sequence is for your system, if it is other than the example just given for an Apple computer.

The ESCape character is not generated by typing "E S C" in a 3 character sequence on the keyboard.

Once you have directed output to the P-150 from your host, enter the appropriate sequence which comprises the ESCape character. Here is a complete example for the Apple II which will set 8 lines per inch. The normal internal sequence for changing the number of lines per inch is: ESCape, "S". Please study the reference card and familiarize yourself with the different command sequences. Then this example will be more meaningful to you.

1. PR#1 . Enter Key (Output to printer)
2. CTRL E . No Enter Key
3. S . No Enter Key
4. PR#0 . Enter Key (Output to CRT)

The printer now has 8 lines per inch set.

To set the printer at 6 lines per inch from the keyboard using an Apple II system type the following example:

1. PR#1 . Enter Key
2. CTRL E . No Enter Key
3. T . No Enter Key
4. PR#0 . Enter Key

The number of lines per inch is now set to 6.

On most CP/M computers the sequence to send a command from the keyboard to change to 6 lines per inch is:

1. CTRL p
2. CTRL [or ESC
3. S
4. CTRL p

Issuing Commands from Word Processors

By the use of printer commands to underline, print in double wide characters and the like, the appearance of a printed page can be enhanced. Many word processors allow the user to define functions to be sent to the printer. For instance in WordStar, one of the more popular word processing packages, the user can define four functions to be any character strings desired. To set the printer to printing 8 lines per inch, a user defined function could be set to send out the two decimal codes 27 and 19 for the ESCape and command characters.

WordStar has four such user defined functions. In addition, there are other command functions that WordStar allows you to change. One of these functions such as "Change Ribbon" could be patched to send out the functions 27 and 19 which correspond to the ESCape character and the Set 8 LPI.

A final method would be to use one of the user definable functions as just an ESCape character. To send the printer a command then, you would type in this user defined function and then follow the function with one of the printable commands, such as the letter "S".

SINGLE CHARACTER COMMANDS

In the following list, the name of the command is followed by its ASCII character, its Octal, Decimal and Hexidecimal value and a description of its function. In some cases there are two characters that may be optionally used as the command character. This is to facilitate the use of the P-150 on varicus host computers, some of which have handlers that do not allow the passing of ASCII commands to a printer. When two such characters are usable as commands, both are given.

CARRIAGE RETURN (CR, 015, 13, 0D) -- Causes the current line to be printed. if the Auto Line Feed Switch (SW1-3) is set ON, a Line Feed will also take place.

LINE FEED (LF, 012, 10, 0A) -- causes the current line to be printed and the paper to advance one line.

FORM FEED (FF, 014, 12, 0C) -- Causes the current line to be printed if there is a non-terminated line of data in the buffer and advances the paper to the next Top Of Form position.

BEGIN UNDERLINING (SO, 016, 14, 0E) -- causes the printer to start underlining with the next character and to continue to the end of the line being printed or until instructed to End Underlining. Note that this command code is the same as the Print Elongated Code, but it is NOT preceded by an ESCAPE.

END UNDERLINING (SI, 017, 15, 0F) -- causes the printer to terminate underlining with the last character printed. Note that this command code is the same as the Stop Elongated Code, but it is NOT preceded by an ESCAPE.

BACK SPACE (BS, 010, 8, 08) -- Designed to enable the printer to overprint the characters preceding and succeeding the command. This command is most often used in printing special character sets such as those used in APL or to double strike a character for a darker image. Note that the Back Space command actually operates just as it does on a typewriter. The print head prints one character and prints the second character over the top of the preceding character.

TERMINATE GRAPHICS MODE -- Causes the current line of graphics mode data to be printed and the paper to be advanced the number of dot positions specified in the last four bit positions. The ASCII characters "0" through "?" are recommended for use as the graphics terminators. They advance paper their value. For instance "0" does not advance paper but does terminate graphics mode. "1" advances the paper one dot position, "2" two dot positions, "?" advances 15 dots, etc.

MULTIPLE CHARACTER COMMANDS

(Escape precedent)

All of the commands that follow are sent to the printer in a two character command sequence in which the first character is always the standard ESCAPE character.

Valid First Character

ESCAPE (ESC, 033, 27, 1B) -- Initiates an Escape Command Sequence which causes the next character received by the printer to be interpreted as a command.

Valid Second Characters

PRINT ELONGATED (SO, 016, 14, 0E) or (N, 116, 78, 4E) -- causes the printer to print the following characters in elongated mode.

STOP ELONGATED (SI, 017, 15, 0F) or (O, 117, 79, 4E) -- Causes the printer to stop printing characters in elongated mode. The printer powers up in a non-elongated mode.

SKIP OVER PERF ENABLE (NAK, 025, 21, 15) or (U, 125, 85, 55) -- Causes the printer to advance one inch beginning a half inch from the bottom of the current form.

SKIP OVER PERF DISABLE (SYN, 026, 22, 16) or (V, 126, 86, 56) -- Causes the printer to print continuously as data is received without regard for perforations in the paper.

PRINT GRAPHICS (ETB, 027, 23, 17) or (W, 127, 87, 57) -- Causes the printer to interpret the following data characters as graphics characters where the lower six bits are used to identify which of the six print wires are to be printed in a direct bit for dot pattern. Graphics mode is usually terminated with the special graphics mode terminators. NOTE: The printer powers up with Graphics Mode disabled.

SET 6 LPI (DC4, 024, 20, 14) or (T, 124, 84, 54) -- Causes the printer to begin printing at six lines per inch.

SET 8 LPI (DC3, 023, 19, 13) or (S, 123, 83, 53) -- Causes the printer to begin printing at eight lines per inch.

SET 204 COLUMNS (ESC, 033, 27, 1B) or ([, 133, 91, 5B) -- Causes the printer to begin printing in 204 columns per line, 15 character per inch mode. In graphics mode, it sets the horizontal resolution to 75 dots per inch. Note: This command can be set only programmatically or via the SoftSwitch Status Keypad.

SET 136 COLUMNS (FS, 034, 28, 1C) or (\, 134, 92, 5C) -- Causes the printer to begin printing in the standard 136 columns per line, 10 characters per inch mode. In the graphics mode, it sets the horizontal resolution to 50 dots per inch.

SET 163 COLUMNS (GS, 035, 29, 1D) or (], 135, 93, 5D) -- Causes the printer to begin printing in the 163 columns per line, 12 characters per inch mode. In the graphics mode, it sets the horizontal resolution to 60 dots per inch.

SET SERIF FONT (RS, 036, 30, 1E) or (^, 136, 94, 5E) -- Causes the printer to begin printing in the high quality 11 X 9 serif font, 136 columns per line, 10 characters per inch mode. In the graphics mode, it sets the horizontal resolution to 80 dots per inch.

SET 231 COLUMNS (US, 037, 31, 1F) or (0, 137, 95, 5F) -- Causes the printer to begin printing in the standard 231 columns per line, 17 characters per inch mode. In the graphics mode it sets the horizontal resolution to 85 dots per inch.

SET FORM LENGTH COMMANDS: All of these commands establish the current position of the paper in the printer as the Top Of Form position and set the form length to the indicated length.

This table shows valid forms lengths acceptable to the P-150.

FORMS LENGTHS TABLE

ASCII, OCT, DEC, HEX	DESCRIPTION
0, 060, 48, 30	-- Sets Form Length to 0"
1, 061, 49, 31	-- Sets Form Length to 3"
2, 062, 50, 32	-- Sets Form Length to 3.5"
3, 063, 51, 33	-- Sets Form Length to 4"
4, 064, 52, 34	-- Sets Form Length to 4.5"
5, 065, 53, 35	-- Sets Form Length to 5"
6, 066, 54, 36	-- Sets Form Length to 5.5"
7, 067, 55, 37	-- Sets Form Length to 6"
8, 070, 56, 38	-- Sets Form Length to 7"
9, 071, 57, 39	-- Sets Form Length to 8"
:, 072, 58, 3A	-- Sets Form Length to 8.5"
;, 073, 59, 3B	-- Sets Form Length to 9.5"
<, 074, 60, 3C	-- Sets Form Length to 10"
=, 075, 61, 3D	-- Sets Form Length to 11"
>, 076, 62, 3E	-- Sets Form Length to 12"
?, 077, 63, 3F	-- Sets Form Length to 14"
ASCII, OCT, DEC, HEX	

PROGRAM CONTROL EXAMPLES

These examples demonstrate programmatic control of the P-150 for doing mode changes.

Horizontal Tab

The P-150 has a "tab position" that can be set for each column of print.

Using program control, tabs are set using the following command sequence:

```
E
S I n , n , n , ... , n .
C    1   2   3         k
```

Where

k is between 1 and 231.
n is between 1 and 231.
A comma "," separates entries
Any non-numeric character
terminates the command, but
a period "." is recommended.
A CTRL-I (HT) may be used instead
of the "I" except with the Bell & Howell
Apple Auto-Plot I/F card which
requires the use of the "I".

1. The tab positions must be in order beginning with the lowest number first.

2. An out of range number terminates the command without setting new tabs.

A Set Horizontal Tab command sequence without any value given for n clears all tabs.

Example: ESC I .

The issuance of an HT command to the printer not preceded by an ESCape command results in an actual Horizontal Tab being executed. When executed, the effect of the HT command is to insert sufficient spaces into the print stream to position the print head at the next horizontal tab position set.

Vertical Tab

Vertical tab may be viewed as a Vertical Format Unit. Up to 8 "channels" or tab stops may be set. Reference is made from the top of form position, considered to be line one.

The command sequence to set vertical tabs under program control is:

```
        E
S K n , n , ... , n .
C    1   2         8
```

Upon receipt of the command, the P-150 first clears any vertical tab settings issued previously and then sets new tabs.

Where "n" is the decimal number of the line at which a vertical tab is to be set. A CTRL-K (VT) may be used instead of the "K."

Up to 8 vertical tabs may be set. Tab stops are separated by a comma ",". Any non-numeric character terminates the command, but a period "." is preferred.

The numbers must be in ascending order. An out of sequence number terminates the command.

"n" can be any number from 1 to 249 (31 inches of paper at 8 lines per inch). An out of bounds number terminates the VT set mode command without setting new tabs. The printer uses the last three numbers entered directly preceding the delimiting "," and uses those three numbers to specify the VT position.

A Set Vertical Tab command sequence without any value given for n clears all tabs.

Example: ESC K .

The issuance of a VT command to the printer not preceded by an ESCape results in an actual vertical tab execution. The effect of this command is to insert sufficient line feeds into the print stream to space paper to the next vertical tab setting.

Skip Over Perforation

When Skip Over Perforation is set, the printer skips the last one inch of the form. Normally the Top Of Form (TOF) position is not the first printable line on the form, but the first line of print. Thus if the TOF is 1/2" from the actual top of the paper, Skip Over Perforation will skip 1/2" at the bottom of the current form and an additional 1/2" at the top of the next form.

Under program control, Skip Over Perforation is set by the following sequence:

E N
S A
C K

Under program control, Skip Over Perforation is disabled by the following sequence:

E S
S Y
C N

DOWN LINE LOADING FONTS

The use of a down line loadable character font requires a minimum 4K of internal buffer in the P-150. When a down line loadable font is loaded in the printer, 2K of the buffer is used for the fonts, and 2K is used for data. The presence of a MemoryMate card does not alter the need for a 4K internal memory to be able to use Down Line Loadable fonts.

The following constraints are placed on the font definitions:

1. Fonts are not printed in graphics mode, but in print mode. Therefore a space is placed automatically between characters. The use of adjacent block graphics characters is prohibited.

2. Two types of fonts, one seven dots wide and a "Serif Font" eleven dots wide, may be down line loaded. Both fonts may be down line loaded at the same time. If only one font is loaded into the printer, the full 2K of font storage area is still reserved.

Down line loaded character fonts are loadable only under program control. The following command sequences are used:

```
E B
S S 1316 bytes of data -- This command loads
C                              a seven wide font.
     An "H" may be used instead of a BS.

E A
S C 2068 bytes of data -- This command loads
C K                            an eleven wide font.
     An "F" may be used instead of a ACK.
E S
S T   --  Shift To Alternate Font
C X
     A "B" may be used instead of an STX.

E E
S T   --  Shift To Internal Font
C X
     A "C" may be used instead of an ETX.
```

E C
S A -- Clear Buffer of Alternate Font
C N

An "X" may be use instead of a CAN.

If an attempt is made to print an alternate character font and an alternate character font has not been loaded, the P-150 will default to the standard character font.

When a request is made to load an alternate font under program control, the P-150 requires that the full and complete data byte stream be sent. A seven wide font must contain 1316 bytes of data and a eleven wide font must contain 2068 bytes of data. If the complete data stream is not sent, the P-150 waits until the complete byte stream is sent.

It is always assumed that the ASCII "SPACE" and "DELETE" (the first and last characters is the ASCII Code Table respectively) are always specified and not down line loadable. Therefore the first loadable character corresponds to the "!" in the ASCII Table.

The printer operates using the standard 7 bit 96 character ASCII set as defined in the Appendix of this manual. It is suggested that a font to be down line loaded follow the ASCII conventions so that your redefined "A" is still printed with a hex 41.

There are 96 possible characters, two of which ("SPACE" and "DELETE") are not allowed, leaving 94 printable characters. Each seven wide character requires seven bytes of data in the printer's memory. Each byte is sent to the printer as the lower four bits of two seven bit characters. Therefore the number of bytes that must be sent to the printer to define a seven wide character set is 94 x 7 x 2 = 1316.

FONT DATA DEFINITION

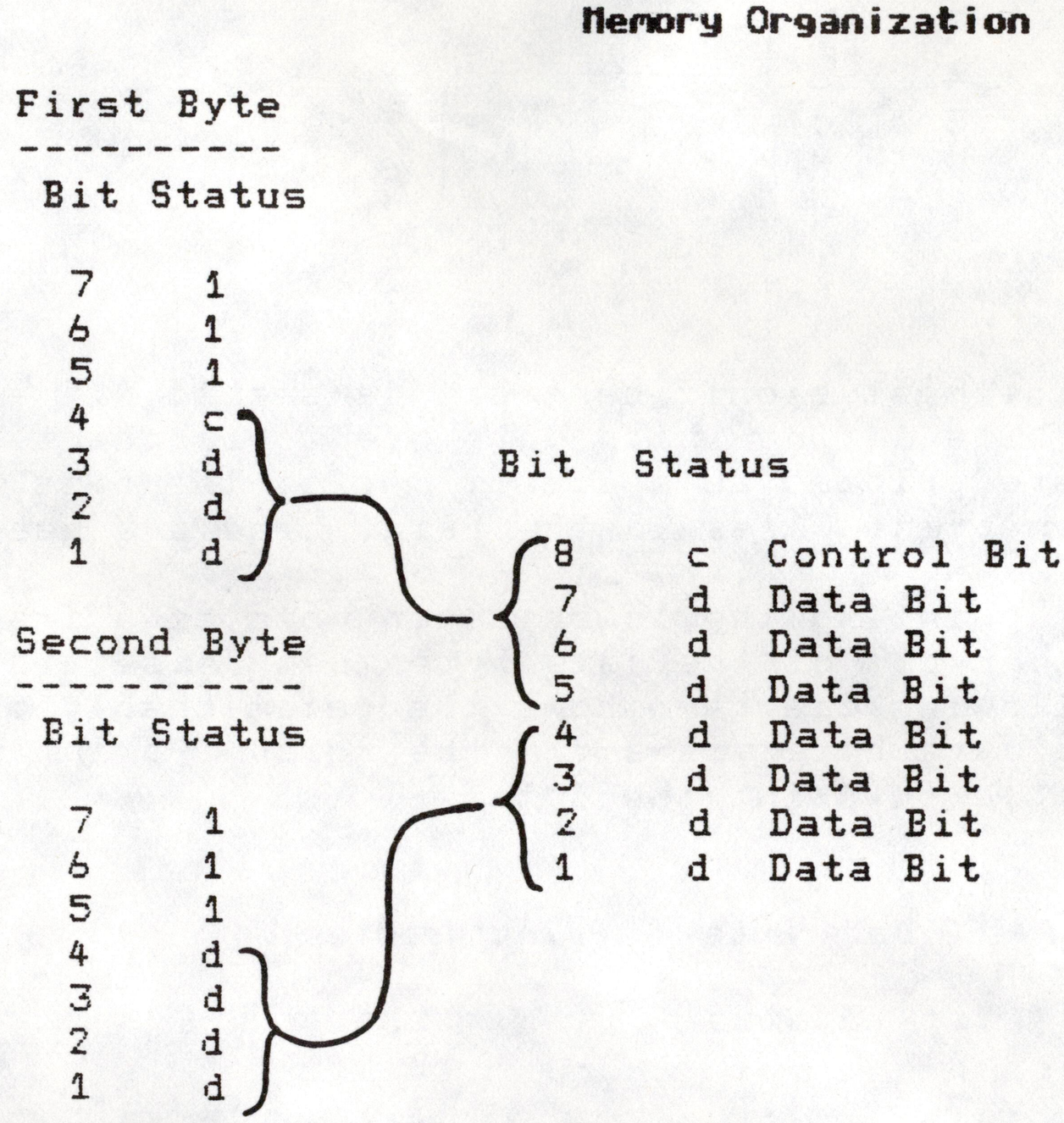
A frame is defined as a vertical row of dots. A standard character is composed of seven vertical frames and the "Serif Font" character is composed of eleven vertical frames.

Only four of seven horizontal dots may be printed with a standard character font or six of eleven in the serif character font. These dots may be contiguous or noncontiguous, but no dot may overprint another dot.

Only seven of nine vertical dots may be printed in any one frame. Moreover, the selected seven dots MUST be composed of either the upper seven contiguous dots or the lower seven contiguous dots.

The format of data to define an alternate character font is based on the transfer of two bytes of data from the host for each printable frame in the P-150.

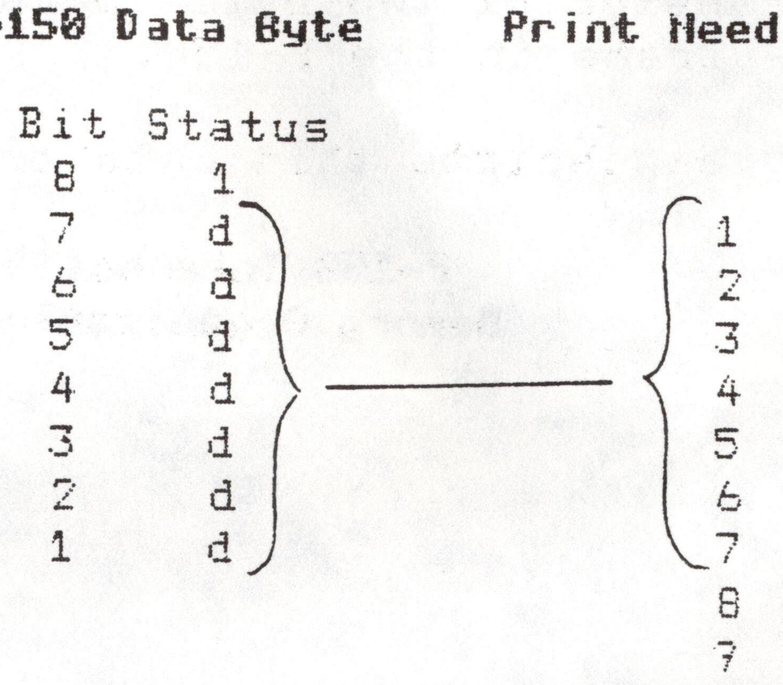
The following diagram depicts this data transfer:



These "1" bits MUST ALWAYS be on when transferring character font data to the P-150. "d" denotes a data bit. A data bit, of course, may be off or on.

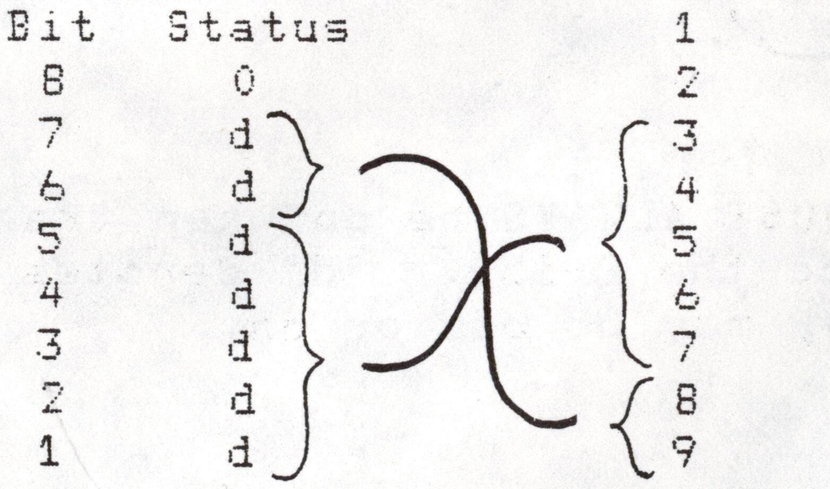
When the data is received and assembled by the P-150, the Control Bit, designated as "c" in the above example, determines which set of seven dots may be printed as described below.

1. For printing the top seven dots of a frame, the high order bit must be set to "1". The following diagram shows the relationship of P-150's data byte vis-a-vis the P-150's print needles which fire to print the dots.



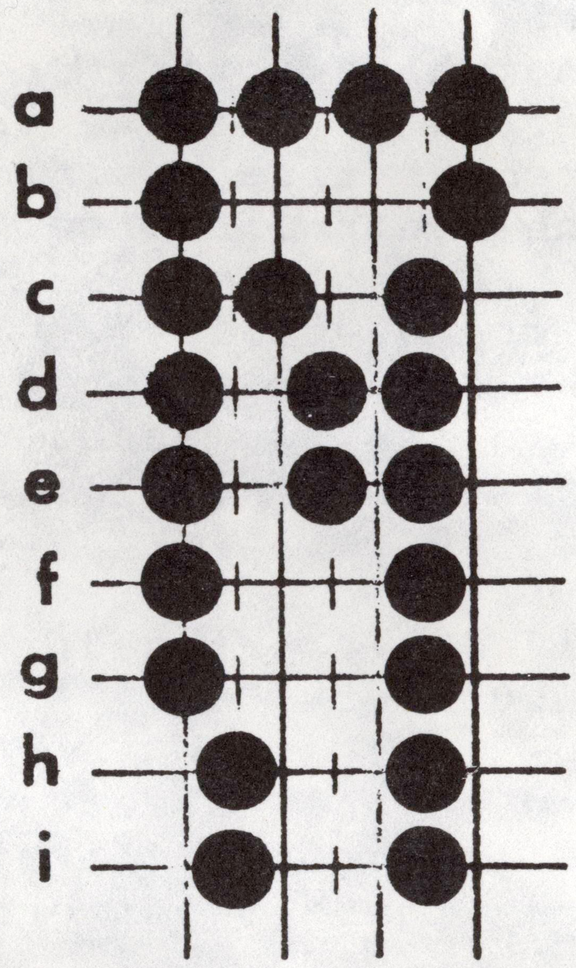
Where the most significant bit is set to "1" and the lower seven bits define which dots are to be printed. The seven dots are printed as a direct map of the bits, and only the top seven print wires in the print head are used.

2. For printing the lower seven dots of a frame, the high order bit of the data byte must be set to a "0". The following diagram shows the relationship of the P-150's data byte vis-a-vis the P-150's print needles which fire to print the dots.



Where the most significant bit is set to "0" and the lower seven bits define which dots are to be printed. Notice the dots are NOT a direct map of the bits. This manipulation is handled by the P-150 and it is entirely transparent to the programmer.

The dot pattern below, which might represent some hypothetical special character, will illustrate how a character is formed using the conventions of the down line loadable print fonts.



1 2 3 4 5 6 7

It is a seven wide by nine high character. The seven vertical frames are represented by the numbers 1 to 7. The character is made up of four "full dot positions" represented by the odd numbers, and of three "half dot positions" represented by the even numbers.

Frame 1 consists of all of the top seven dots. In the printer memory, the control bit (b8) would be set to 1 to signify that the top seven dots are to be printed. All of the remaining bits will likewise be set to "1" to signify that all of these bits are to be printed. In the printer's memory, this frame would be stored in memory as "1111 1111" or as represented in hexidecimal notation -- "FF".

Frame 2 cannot have any of the top seven dots printed. It is not permitted for adjacent, or overlapping, dots to be printed. The print wires simply do not oscillate that fast. Consequently, the only dots that could be printed are the two descenders. In the printer memory the control bit (b8) would be set to 0 to signify that the lower seven bits are specified by the remaining bits. Referring to the bit

pattern for describing the descending bits, they are represented by b7 and b6. In the printers memory, this frame would be stored as "0110 0000" or again in hex -- "60".

Frame 3 could have any dots printed except the two descenders which would overlap with Frame 2. For illustration purposes, dots a and c are to be printed. The control bit (b8) would be set to signify that the upper seven bits are to be printed, it would be a 1. The bit pattern then would be "1101 0000" or in hex -- D0.

Frame 4 could not have dots a or c printed. For illustration purposes, dots d and e are to be printed. These dots, in the center five positions of the frame, may be specified with the control bit set to either 0 or 1. Either of these two bit patterns would print the proper pattern "1000 1100" or "0000 1100". Note that the lower five bits specify the same five dots in either control mode. The only difference in the two modes is to specify if bits b7 and b6 specify dots a & b or h & i. In hex these bit patterns are "8C" or "0C".

Frame 5 has only dot a printed. In memory this is specified as "1100 0000" or "C0".

Frame 6 consists of the lowest seven dots. The control bit (b8) is set to 0 to signify that the lowest dots are to be printed. In memory the bit pattern would be "0111 1111" or in hex -- "7F".

Frame 7 can consist of only some combination of the top two dots as printing any of the other seven would require overlapped dots. In the illustration, the top two dots are printed. The bit pattern stored in the printer's memory would be "1110 0000" or in hex -- "E0".

To print this character then, the following sequence, expressed in hexidecimal, would be stored in the printer's memory: "FF 60 D0 8C C0 7F E0".

To load this character string into the printer, each byte of information is sent to the printer in two bytes with the upper half byte set to "0111" or "7". The first byte, FF which represents frame 1, is transmitted in two bytes as 7F 7F. The data stream to be sent to the printer to produce this character is: "7F 7F 76 70 7D 70 78 7C 7C 70 77 7F 7E 70".

Note that all of these bytes begin with 7, and that this corresponds to the column of the ASCII code chart representing the lower case letters p to z and certain special characters. From a BASIC program this character

string could be sent to the printer using the lower case letters and special characters or with a series of CHR$ functions. Remember that the control sequence to tell the printer to load a seven wide font is an ESCAPE-BS, or CHR$(27) and CHR$(8). The following data stream would load this character into the first printable character location in the memory.

```
CHR$(27);CHR$(8);CHR$(127);CHR$(127);"vp";CHR$(125)
;"px";CHR$(124);CHR$(124);"pw";CHR$(127);CHR$(126);
"px";CHR$(124) -- this string would then be
followed by 1302 additional bytes of font
information.
```

This special character would be loaded into the first printable location in the printer's memory. This corresponds to the location normally used to store the information for printing the Exclamation Point -- again reference the ASCII Code Chart. Therefore, whenever printing from an alternate font is desired -- subsequent to the receipt of an 'ESCAPE-STX" -- any time an Exclamation Point is sent to the printer, this character will be printed.

GRAPHICS

GETTING STARTED

This chapter discusses the P-150's graphics feature. It should be read in conjunction with the previous chapter on programming.

The P-150 has the capability of printing high resolution graphics with the host retaining control of each dot printed. Under programmatic control, a single dot can be positioned anywhere on the page of paper.

First, let's discuss the physical attributes of the P-150's print head.

The nominal physical dot diameter of a print wire is .014 inches. The vertical resolution of the printer is 72 dots per inch. Horizontal resolution can be 50, 60, 75, 80 or 85 dots per inch. Horizontal resolution is determined by the P-150's initialization. Remember that initialization occurs when power is turned on and it is predicated on either (1) the DIP Switch settings, or (2) entries made through the Softswitch Status Keypad. All settings established at initialization may be altered programmatically.

There are nine vertical print wires in the P-150's head. Graphics printing is accomplished by using only six print wires. When the printer is operating in graphics mode, the lower six bits of a byte are translated on a one for one basis to operate the six print wires.

The following table shows the arrangement of the vertical print wires and their relation to the bit pattern within a byte. Whenever a bit is set to the "1" state, the dot will be printed.

PRINT WIRE	PURPOSE
1	Not Used
2	Controlled by Bit 6
3	Controlled by Bit 5
4	Controlled by Bit 4
5	Controlled by Bit 3
6	Controlled by Bit 2
7	Controlled by Bit 1
8	Not Used
9	Not Used

Graphics print data is sent from the host to the printer in eight bit bytes. Each byte represents one vertical frame of graphics print. The following table shows a byte and the corresponding function of each bit.

BIT	PURPOSE
8	Ignored (Most significant bit)
7	Indicates graphics data
6	Data
5	Data
4	Data
3	Data
2	Data
1	Data (Least significant bit)

Dot Control Configuration

Bit seven must be a "1" to indicate graphics data. Generally speaking if bit seven is not a "1" but a "0", the byte is interpreted as a termination character and graphics mode is ended. The few exceptions to this rule are commands which are discussed later. Every pass of the print head accounts for 6 vertical dots.

To establish graphics mode the printer must receive the following ESCape sequence: ESC ETB. Thus a stripe of graphics data would look like this:

```
E E G ------------  T
S T :R             :  E
C B : A            :  R
    :  P           :  M
    :   H    D     :  I
    :    I    A    :  N
    :     C    T   :  A
    :      S    A  :  T
    :              :  O
    :--------------   R
```

Every graphics line must begin with the ESC ETB sequence. The ASCII character ETB is produced by a CHR$(23) and the ESC is produced by a CHR$(27). A table of valid Graphics Patterns is in the appendix. The table shows the decimal value and character which causes the different graphics patterns to be printed.

As an example, if you reference the Graphics Pattern Table, you will see that the following Apple keyboard characters generate the bit patterns given below (lower 7 bits only):

Character	A	C	G	O
Bit Pattern	1	1	1	1
	0	0	0	0
	0	0	0	0
	0	0	0	1
	0	0	1	1
	0	1	1	1
	1	1	1	1

The topmost bit in each of these characters is a "1" indicating graphics data. The other bit patterns, if printed graphically, would result in a "ramp" which would look like this:

```
                o
              o   o
            o   o   o
          o   o   o   o
```

On the printed page the actual dots would be much smaller than the ones used here. In fact the ramp would be four dot positions wide, just about half the width of one of the characters used in this text.

When graphics mode is established, all subsequent data characters are interpreted as graphics characters so that any combination of the lower six bits is a printable "character." Again, all graphics data must have bit 7 set to the "1" state. This signifies to the printer that the character is indeed a graphics character.

The graphics printing mode will continue until the printer receives a graphics termination code. The normal termination code is an ASCII character "0" through "?". This termination character will tell the printer to print the stored line of graphics data, to advance the paper the amount specified in the command, and to terminate the graphics mode. Remember, a graphics termination character is any noncontrol character that does NOT have bit 7 set to "1".

EXAMPLE GRAPHICS PROGRAMS

Here are some examples. They are written in BASIC for an Apple computer, so you may have to make some format modifications for your particular system.

This program will draw a line on the printer.

```
10 PRINT CHR$(4);"PR#1" : REM Direct Output to
Printer
20 PRINT CHR$(27);CHR$(23);
30 PRINT "AAAAAAAAAAAAAAAAAAAA";
40 PRINT "6"
50 PRINT CHR$(4);"PR#0" : REM Direct Output to CRT
```

Line 10 is the Apple method of directing output from PRINT statements to the printer which is located in slot 1.

Line 20 is the ESCape/Print Graphics sequence.

Line 30 is the graphics data, in this case a row of single dots.

Line 40 is the graphics termination character with a paper advance of 6 dot positions. "6" is used to advance the paper away from the line of graphics just printed. Remember, the head is printing up to 6 vertical dots on each pass.

Line 50 is the Apple method of directing output back to the CRT screen.

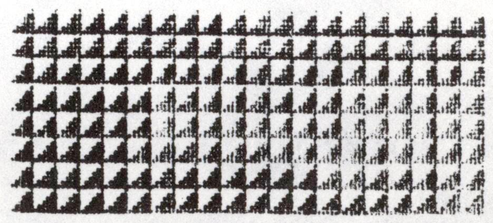


EXAMPLE 1 RESULTS

Here is an example that would print a pattern of little ramps 20 ramps wide by 10 ramps high. Again the example is for an Apple computer.

```
10 A$="ACGO"+CHR$(95)+CHR$(127)
20 PRINT CHR$(4);"PR#1"
30 FOR J = 1 TO 8
40 PRINT CHR$(27);CHR$(23);
50 FOR I = 1 TO 20
60 PRINT A$;
70 NEXT I
80 PRINT "6";
90 NEXT J
93 PRINT
95 PRINT CHR$(4);"PR#0"
```

Here is the output from the above example:



EXAMPLE 2 RESULTS

A$ has the little ramp mentioned earlier, but also the next two frames in the ramp, i. e., five and six vertical dots. These characters cannot be entered from the Apple keyboard, so the decimal equivalents from the Graphics Pattern Chart are put into the string with the CHR$(95) and CHR$(127) functions.

The ESC and Print Graphics characters are put into the program with statement number 40. They could have been added to the string A$ if we had not intended to print the string so many times, but it is usually easier to understand if commands and data are not intermixed.

If you are sending this data with a BASIC "PRINT" statement, you must use semicolons, NOT commas to separate variables and you must use a semicolon at the end of your PRINT statements. Commas cause spaces to be sent to the printer, and no semicolon at the end causes a Carriage Return, Line Feed sequence to be sent. The PRINT statements all end with a semicolon to signify that the printed material is NOT to be terminated with a Carriage Return by the computer. Instead, the line termination character should be a character chosen by the user to accomplish the amount of form advance that is to occur.

Some BASIC languages will force a Carriage Return into the print string after some pre-determined line length has been reached, typically 80 or 132 characters. This will terminate the graphics mode of the printer causing the remainder of the graphics string to be printed as standard ASCII characters. Most of these BASIC's provide for some procedure to defeat this automatic CR insertion. The instruction WIDTH LPRINT 255 will set an infinite line length on many BASIC interpretors. It may be necessary to use commands other than the normal PRINT command to get the graphics data sent to the printer. These procedures may use the OUT/WAIT, PEEK/POKE, CALL, USR or other procedures. The description of these commands is beyond the scope of this manual, please consult the manuals of the specific computer system in use.

While in graphics mode, the receipt of a Carriage Return and/or Line Feed sequence operates the same as when the printer is in alphanumeric mode. These commands will cause the paper to advance 1/6 or 1/8 inch (depending on the vertical spacing mode of the printer). 1/6 inch corresponds to 12 dots positions, 1/8 inch corresponds to 9 dot positions. In graphics mode six dots are being printed on each line, so a 6 dot paper advance is most commonly used.

ACTIVE COMMANDS

Active commands are those commands which are recognized by the printer while in graphics mode. They will serve to terminate the printing of the current line and end the graphics mode. The commands that normally advance paper (CR, LF, FF and the graphics termination codes) and the Set Form Length commands terminate the graphics mode and advance paper. The remaining commands will not advance paper.

COMMAND	ASCII
Print Graphics	ETB
Set 136 Columns	FS
Set 163 Columns	GS
Set 204 Columns	ESC
Set 231 Columns	US
Skip Over Perf Disable	SYN
Set Serif Font	RS
Skip Over Perf Enable	NAK
Horizontal Tab	HT
Back Space	
Load and Use Fonts	
Tab Set Commands	
All Set Form Lengths Commands	

The Horizontal Tab command is operational in graphics mode.

Normally these commands are not used to terminate the graphics mode. However, if you were printing graphics and issued another Print Graphics command, the present line would be printed, the head would move back to the home position and the printer would overprint what you just printed. The commands are listed here to help you avoid problems.

NON-ACTIVE COMMANDS

Non-Active Commands do not affect the printer while the printer is in the graphics mode. However, they do set different internal status registers and therefore will affect the operational mode of the printer when the graphics mode is later terminated. They will not terminate the graphics mode.

COMMAND	ASCII
Print Elongated	SO
Stop Elongated	SI
Set 6 LPI	DC4
Set 8 LPI	DC3

ADDITIONAL CONSIDERATIONS

Graphics and alphanumeric data may be printed on the same line by printing a line twice. That is, if a line on the paper is to have graphics information on its left hand side, the graphics information could be printed with a terminator that specifies no paper advance. The alphanumeric data could then be printed using spaces to move the print head over the previously printed graphics information. At the conclusion of the alphanumeric data, the graphics mode could be entered and terminated without printing to space the paper the desired number of dots.

All alphanumeric data must be terminated with a CR, LF, or FF control character before entering the graphics mode. If it is not, the ESC ETB control sequence will terminate the line of alphanumeric data and cause the print head to go to the left margin WITHOUT SPACING THE PAPER. The subsequent line of graphics data will be overprinted on the previous line of alphanumeric data.

The P-150 does all of its graphics printing in a unidirectional print mode. A "quick return" feature is provided to allow the rapid return of the print head to the left side of the picture to increase the system thruput. Therefore the print head will always be moving in a left to right direction for all its graphics printing.

The P-150 does not automatically wraparound when operating in the graphics mode. Any graphics bytes beyond the selected line length will be truncated and lost. The printer will wait until it sees a valid terminating character at which time it will print the line of graphics data.

The printer will keep track of the selected form length while in the graphics mode. However, if the Skip Over Perf is enabled, care should be taken to properly select the form length and align the form or the one inch skip area may appear in the graphics printout. This can be eliminated by disabling the SOP feature or by setting the form length to zero.

Unless the host keeps track of the number of vertical dots it has stepped during a graphics printout and corrects for partial lines, any data printed in the alphanumeric mode following graphics data may not be printed on the correct line space increments. This is always referenced to the present position of the head, which may be at a partial line position. The P-150 will not realign the line spacing until it does a Skip Over Perforation operation or receives a Form Feed command either from the host or via the front panel Paper Advance switch. At that time, it will advance the paper to the next selected Top Of Form position.

The P-150's tractor drive mechanism provides long term accuracy characterized by nonaccumulative errors. However, the short term accuracy is affected by paper shift, tractor hole variations, paper tension, paper expansion, etc. This in turn can be reflected in the vertical registration of the graphics printout.

Therefore, it is recommended that at least one form length of paper be electrically driven through the printer to settle the paper path. The paper supply must be positioned to permit free and unobstructed paper movement. The paper tension must remain constant for the duration of the graphics printout to facilitate precise and accurate graphic printing.

PERIODIC MAINTENANCE

This chapter discusses the P-150's maintenance and the changing of expendables, i.e., ribbons and paper. While the P-150 is designed to require an absolute minimum amount of maintenance and service, it is a mechanical device which requires cleaning and preventative maintenance. Proper care will greatly extend the printer's reliability and reduce downtime.

RIBBON CHANGE

To change the ribbon on the P-150 follow this procedure.

1. Remove the smoked translucent plate from the top of the P-150 by pushing directly down and backward on the center of the plate.

2. Open the tractor doors and lay the paper toward the front of the printer, out of the tractor pins. Then remove the paper from the printer.

3. If necessary, release the clamps holding the tractors and slide them toward the middle of the printer.

4. Release the ribbon cartridge by depressing the two lateral clips and lifting the cartridge up and out of the printer.

5. Take the new ribbon cartridge and guide it under the tractor door. Set the ribbon cartridge into position under the two retaining clips.

6. The nylon ribbon must be in front of the ribbon guide. To ensure that the ribbon cartridge is properly seated, turn the small white ribbon tensioning knob on the right side of the cartridge. Take all slack out of the ribbon.(see Appendix 1, Figure 3A)

7. Realign the tractor doors and load the paper. Thread the paper between the ribbon and cartridge. Don't forget to set the Top-of-Form before resuming printing.

8. Replace the translucent cover. Do not operate the printer without the cover as it controls the direction of the cooling air flow.

PAPER CHANGE

To change paper in the P-150 follow this procedure.

1. Remove the translucent cover.

2. Disengage the Select Switch. Feed the paper through the slot located underneath and to the rear of the printer. Be careful not to damage the Out-of-Paper switch as you pull paper upward.
If paper is 8 1/2" it must be to the left.

3. Open the tractor doors. Align the tractor doors to the correct width for the form.

4. Place corresponding paper pin holes in the pin feed mechanism and close the tractor doors.

5. Advance paper to Top of Form and set the Top of Form by depressing the TOF Switch. Engage the Select Switch again.

6. Replace the translucent cover.

LUBRICATION

The parts requiring periodic lubrication are those parts involved with the head, the head guide and its movement. Periodically, every six months in an office environment, more frequently if in a dirtier environment, you should check these parts. Should the print quality of your P-150 deteriorate even the slightest, the problem may be the lack of lubrication on the head shaft. A small amount of lubrication will restore performance to the highest print quality level.

Run your finger along the head shaft. It should feel slick with a thin oil coating. After cleaning, put a small amount of high quality light machine oil on the cylinder guide.

Clean the head shaft with a lint free cloth. Soak the felt washers at each end of the head shaft with oil. These washers maintain a source of lubricant for the head as it traverses the shaft. They should be saturated with oil, but not to the point that they drip.

Clean paper dust and excess ink off components. The paper dust is cleaned by simply blowing it off. Excess ink will collect along the print wires between the drive solenoids and the front of the print head. This excess ink can be cleaned off by turning the printer on its side (so you can see the wires) and then gently cleaning the wires with a cotton swab dipped in alcohol. Be careful, the wires are easily bent. You can expect that enough ink will collect to need cleaning about every three ribbon cartridges.

Finally, when you have the top off and are in a maintenance mood, use a Phillips screwdriver to make sure that all the screws you can see are still tight. These screws are provided with lock washers, but the constant vibration of the head moving back and forth can sometimes cause them to loosen.

EXTERNAL CLEANING

To maintain the attractive appearance of your printer, clean it occasionally with a soft lint free cloth, moistened with a mild cleaning liquid. Never pour or spill liquid directly on the printer, the electronics can be damaged and the mechanism may stick.

TROUBLE SHOOTING

This chapter addresses some common problems which you may be able to resolve yourself. If you have experienced some difficulty with your P-150, review each of the items in this chapter before you return the unit for repair.

Obviously we have not identified every possible problem, only the most common. After you have exhausted these items, you should contact your dealer or Bell & Howell for repair authorization.

UNIT DEAD

If the printer appears completely dead and;

It has a serial interface.

Check to see if the baud rate is set to Auto Baud Rate Select, i.e. the first four dip switches on the serial card are set to zero. If these switches are all off, the printer powers up in a baud rate seek mode.

PP-150

The PP-150 printer, that's the model with the SoftSwitch front panel keypad, will begin a slow beeping. As spaces are sent to the printer, the beeping will continue until the proper baud rate is selected, at which time the rising musical tone will be heard.

On subsequent occasions when the printer is turned on, the baud rate will be set from the battery backed up memory so this procedure need not be repeated.

P-150

The P-150 printer, that's the model without the SoftSwitch front panel keypad, has no speaker so it will appear dead. Specifically, the power on indicator will be on, but neither the SELECT or the STATUS indicators will be on. Normally, when power is first applied to the printer, the print head moves to the right a short distance and returns. When Auto Baud Rate Select is set, the print head will not move in this fashion. When the baud rate has been selected, the SELECT and STATUS indicators will illuminate and the head will move to the right and return.

The P-150 printer does not have a battery backed up memory, so the baud rate selection procedure must be repeated each time the printer is powered up.

1. No Power Indicator

Check to see if the unit is plugged into a working power outlet. Verify that the fuse has not burned out. The fuse is located adjacent to the power switch on the lower right side; it's a 2.0 amp, 3AG. If the printer is blowing fuses it's because you have a problem. Fix the problem or return the printer for repair. Don't put in a larger fuse and cause additional problems.

Check to ensure that the I/O cable connector is connected properly to J4. When it was installed it had the keying pin, if the keying pin has been removed it may have been offset in either direction. If it is offset on J4, the power supply will be grounded.

2. No Select Indicator

Determine if the Select Switch is depressed. It must be depressed for the Select Indicator to light.

3. No Ready Indicator

Check to see that paper is in the printer. The Paper Out Switch may be tested by disconnecting the cable connector from J3. With the connector disconnected, the signal at J3 appears to be "true" (paper installed).

If everything has checked out up to this point, the Self Test Print function can be put into operation by depressing and holding down the PAPER ADVANCE and the TOP OF FORM switches at the same time (while the unit is selected). This test will display a pattern of printed characters.

GARBLED DATA

1. Parallel Interface

Check to see that you are using the proper interconnection cable and that it is properly installed at both the host and the printer ends. And, of course, check to see that the cable is not cut, crimped or electrically shorted.

2. Serial Interface

If you have installed the optional serial interface, check to ascertain that the baud rate switches on both the host and the printer are set for the same baud rate.

Check the stop bits transmitted from the host to the P-150. If the printer ever gets out of synch with the host it may not recover until the end of the message, when the host pauses. Send two stop bits for each character.

SYSTEM HANGING

The next most common symptom of trouble is that the host computer 'hangs' or does nothing. This could be due to the host not recognizing an ACKNOWLEDGE from the printer (in parallel mode) or the REQUEST TO SEND (in serial mode).

If the host is 'hanging' while in parallel mode it may be due to not recognizing the ACKNOWLEDGE from the printer. The PAPER ADVANCE switch can be used to "ACK" characters from the host. Each time the PAPER ADVANCE switch is depressed (while the unit is SELECTED), an ACKNOWLEDGE will be sent to the host. Therefore, if the host has missed the ACKNOWLEDGE due to timing or other problems you can force it to move to the next byte of data. The PAPER ADVANCE switch will force any data that may be in the buffer to be printed. So if anything is printed when this switch is pressed, it is a sign that the printer is at least receiving data from the host.

A common 'hanging' problem in either serial or parallel mode may be that the host is expecting a REQUEST TO SEND or BUSY signal of the opposite polarity. To test for this problem, de-SELECT the printer by releasing the SELECT SWITCH to its out position (the SELECT INDICATOR light will go out). This will make the REQUEST TO SEND or BUSY signal go false. But since this host is expecting a signal of the opposite polarity, it will interpret this signal as 'true.' The host should begin to transmit data. If this is the problem, the REQUEST TO SEND or BUSY signal polarity can be inverted by changing the strap on the printed circuit board.

LOST CHARACTERS

A probable cause is that the host does not recognize the 'BUSY' signal (parallel) or the 'REQUEST TO SEND' (serial). The 'BUSY' indicates that the character buffer is full or the paper is in motion; if the 'BUSY' is ignored, the buffer may overflow and characters will be lost. An ACK pulse will not be sent if the printer goes BUSY. The host must recognize either the ACK or BUSY.

Some hosts may require a character by character 'BUSY' signal (This is a common problem with some personal computers such as the TRS-80 that do not use the ACKNOWLEDGE signal to regulate the data transfer rate). The P-150 can be strapped on the printed circuit board (it is so shipped from the factory) to go active on a character basis or it can be restrapped to operate only on a BUFFER BUSY basis.

LINE FEED PROBLEMS

Problems with the mechanism such as no line feeds, or nonreadable characters are usually the fault of the cable connections on the printed circuit card. But there are a few things that the operator should check.

1. The motor that powers the tractor feed has been deliberately set to provide enough power to pull paper through the printer when there is no extra friction on the paper, but not so powerful that the paper could be torn. If the paper is not advancing, as indicated by improper spacing or multiple lines printed in one place, first be sure that the paper path is clear. A slight amount of tension on the paper supply is desirable to keep the paper seated in the tractor holes.

2. If the tractors are too far apart, they cause extra friction that will sometimes cause partial or full failure to feed paper. This will usually cause the tractor feed holes to be elongated. Moving the tractors slightly closer together should solve the problem.

3. Double Spacing or Over Printing may be due to your Auto Line Feed on Carriage Return being incorrectly set.

4. Finally, check the gears that drive the tractors. Make sure that they are free to turn. Sometimes a large piece of foreign matter will jam the gears, preventing them from turning.

FADING PRINT

HEAD NOT MOVING

CHARACTERS JAMMED TOGETHER

All of these are symptoms of ribbon cartridge troubles.

1. If the printer appears to be operating normally, but the characters being printed gradually fade away to nothing, the ribbon isn't moving. (This may occur just after a ribbon change.) It is caused by the cartridge not being seated on the ribbon drive. Gently push the cartridge down while turning the manual ribbon drive (plastic knob) located on the right hand side of the ribbon cartridge. It will click into place and should solve the problem.

2. If the ribbon should jam solid, it can exert so much friction that it will prevent the head from moving. When this occurs the head will stop in one place and continue to print. This may be caused by a defective ribbon cartridge or by something jamming the ribbon drive.

3. Characters jammed together is usually caused by excessive friction within the ribbon cartridge. That is, the ribbon cartridge has a partial jam. Enough of a jam to slow down the print head, but not enough to jam it in one place.

With the Bell & Howell P-150, the ribbon moves only when the head is travelling from right to left. As such, the jammed together characters will occur only when the head is printing right to left.

UNPREDICTIBLE MODE CHANGES

The most common reason for an unpredictable mode change is that the host is transmitting control codes which are being interpreted by the printer as valid commands. This often happens with immature software. The P-150 is an intelligent printer with far more control codes than earlier generation equipment. Some software sends control codes that would have been ignored by the earlier printers but which are valid with the P-150.

If you are sending Escape sequences to the printer, verify that there are no embedded control codes in the transmitted data.

FINAL TESTING

As a final test you may want to determine if the P-150's microprocessor is cycling properly. It may have hung due to a power fluctuation or due to many other reasons. Power down the unit and bring it back up. If that doesn't work disconnect the cable from the printer and try it again.

If you still haven't made any progress, return the printer for repair.

Appendix 1

UNPACKING

INSPECTION

Each Bell & Howell P-150 has passed a rigorous battery of tests before it was carefully packaged with foam protectors and shipped. Everything has been done to ensure that the printer you get is perfect in every way. Follow these instructions step by step to further ensure that you do not damage your printer as you install it and to keep it in its excellent condition.

NOTE: THE P-150 IS OFFERED WITH SEVERAL DIFFERENT OPTIONS. AS YOU READ THESE INSTRUCTIONS, YOU WILL BE DIRECTED ACCORDING TO THE OPTIONS YOU SELECTED ON YOUR PRINTER. DISREGARD THE INSTRUCTIONS RELATED TO OPTIONS YOU DO NOT HAVE. FOLLOW ALL OTHER INSTRUCTIONS.

1. Visually inspect the shipping container for any obvious signs of damage. It was shipped insured, and if there is any external damage contact the dealer or carrier from whom you received your printer.

2. Open the carton and remove the P-150 from the packing container by reaching into the box and grasping the front and back of the printer firmly. Pull the printer straight up out of the box along with the packaging material.

3. Remove the packing from the sides of the printer and return them to the empty container. Save the container and packaging materials in the event the printer needs to be shipped again.

4. Three items were shipped with the printer.

   a. User's Reference Manual
   (The manual you are now reading)

   b. One printer ribbon (Installed)

   c. Your P-150 printer test pattern

5. Carefully inspect the carton for each of the items. If any items are missing contact your dealer or Bell & Howell representative for a replacement.

6. Inspect the exterior of the printer for scrapes, dents, cracks or chipping. If your printer is NOT damaged, then you should proceed with these instructions. Otherwise notify your dealer or freight carrier immediately.

7. To begin, place the P-150 on a large surface area so that you are facing the printer's front control panel. The front control panel has the Bell & Howell logo in the lower left corner. This is the orientation that will be used for the remainder of this manual as you proceed with its installation.

PHYSICAL DESCRIPTION

The physical features of the P-150 will be described beginning at the front panel. The description will proceed from left to right and finish at the rear of the unit. Use the figures provided to assist you as you read the remainder of this section. (See Figure 1A & 2A)

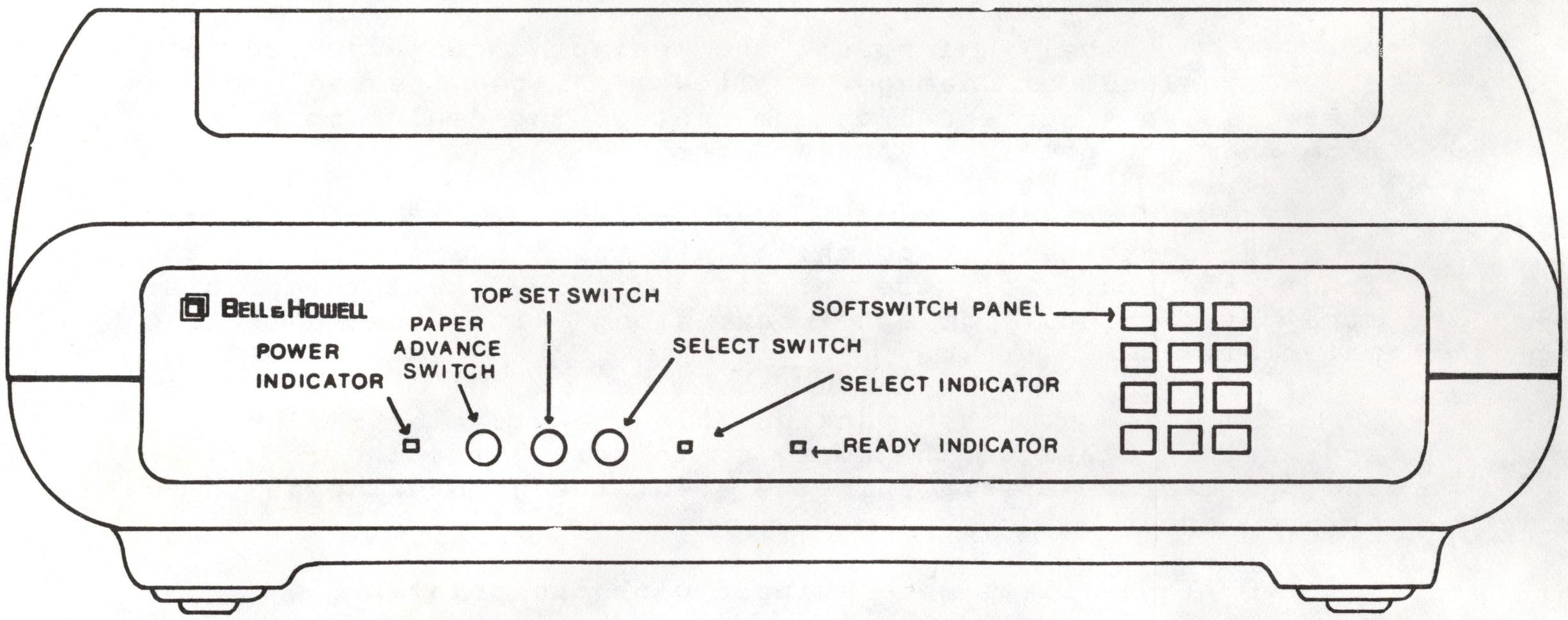


FIGURE 1A

It is recommended that you acquaint yourself with the various components on the P-150, their functions and their locations, and that you invest the requisite time in becoming an able and competent operator of the P-150. The more familiar you are with these components the easier it will be for you to operate and maintain the printer.

POWER ON INDICATOR

The Power On Indicator lights when electrical power is turned on.

PAPER ADVANCE SWITCH

The Paper Advance Switch is a momentary contact switch that is used to advance paper. Each time the switch is depressed the paper is moved one line. If the switch is held for .5 seconds, the printer performs a continuous paper advance and halts at the Top of Form unless the switch is released first.

TOP OF FORM SWITCH

The TOF Set Switch is a momentary contact switch that is used to set the Top of Form when the Select Switch is disengaged (out).

If the TOF switch is depressed for .5 seconds while the Select Switch is engaged (in), it will initiate a high speed paper advance to the next top of form position.

If both the Paper Advance and TOF Set switches are depressed while the Select switch is engaged (in), a test pattern is printed.

SELECT SWITCH

The Select Switch puts the printer on line to the host or takes the printer off line. The Select Switch is an alternate action switch and must be pushed in and engaged to put the printer on line and it must be disengaged (OUT) to put the printer off line. When the Select Switch is disengaged, the Top of Form may be set by depressing the TOF Set Switch.

SELECT INDICATOR

The Select Indicator lights when the Select Switch is pushed in and engaged.

READY STATUS INDICATOR

The Ready Status Indicator lights when the Out of Paper switch (Located inside the printer) is not actuated, i.e., paper is in the printer.

SOFTSWITCH STATUS KEYPAD

The SoftSwitch Status Keypad is used to easily establish and change the different modes in which the printer initializes and operates.

POWER SWITCH

The Power Switch is a rocker switch located underneath the printer on the right side approximately four inches from the front.

FUSE

The fuse is located next to the Power Switch underneath the printer on the right side and is a 2.0 Amp fuse.

OPTIONAL REAR MOUNTED ACCESSORIES

DIP Switch Extender Panel.

Rear mounted "Centronics" connector.

Rear mounted DB25 connector.

If your printer does not have either the optional SoftSwitch Status Keypad or the optional Rear Mounted Extender Panel, then you have the Standard Model of the P-150.

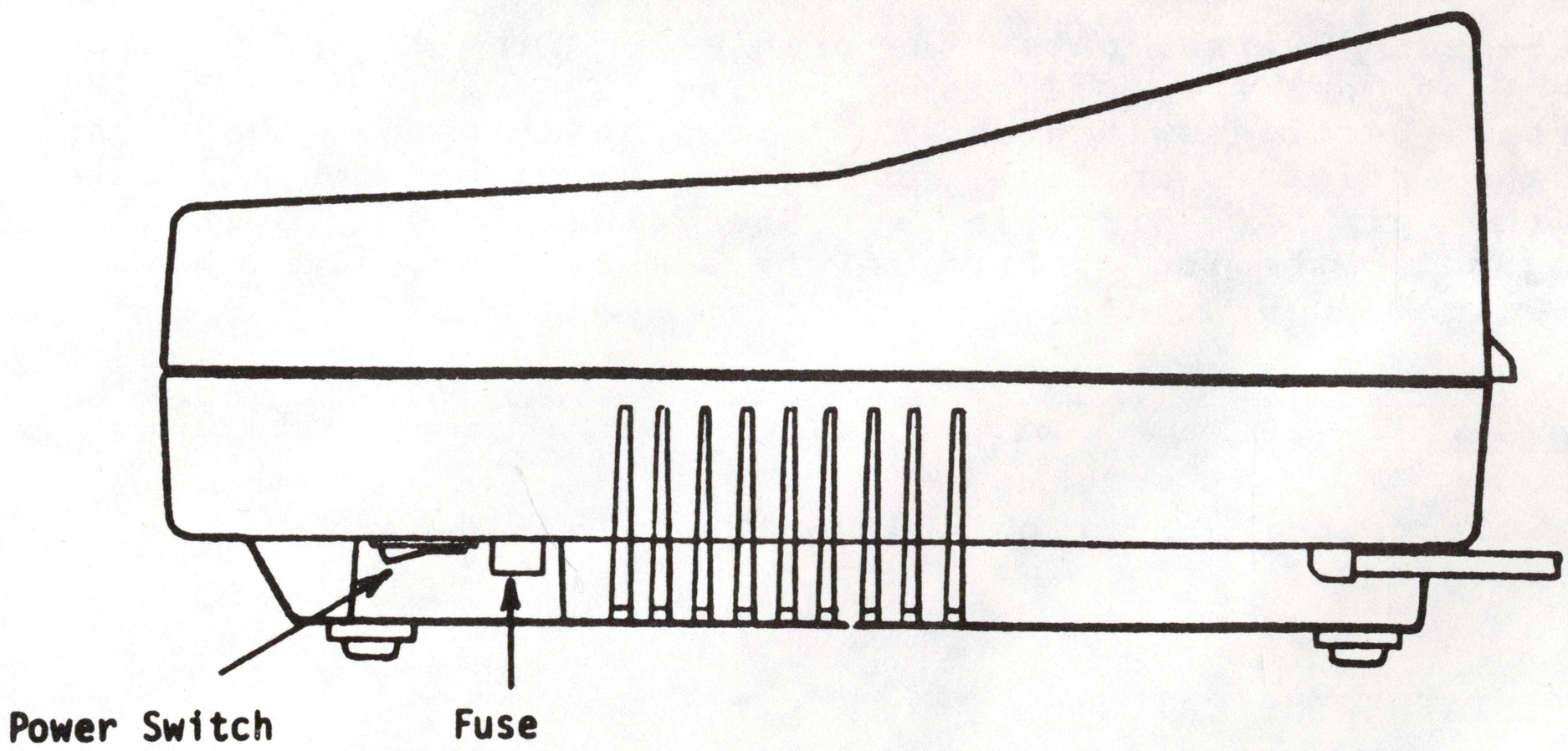


FIGURE 2A

COVER REMOVAL

1. To proceed with installation, it is now necessary to remove the printer's cover. The cover will remain off during the remainder of this procedure. Be cautious as the printer is somewhat heavy.

   a. Lay the printer gently on its back to allow access to the bottom.
   b. Unscrew the four corner screws holding the top and base. The screws will only loosen and cannot be extracted.
   c. Now place the printer back down on its feet and grasping each side of the top cover, lift it straight up and off.

2. With the top cover removed from the printer, make an inspection of the print mechanism and printed circuit assembly as follows:

   a. Remove the strap that restrains the head during shipment.
   b. Check the mechanism for any loose, broken, or extraneous parts due to rough treatment during shipment.
   c. Check the integrated circuits and wiring connector to see that they are firmly seated.
   d. Check to ensure that the head/carriage assembly is free to move along the head guide bar and that no object obstructs its path. The print head should move as it follows the head guide bar. NEVER grasp the print head to move it; it may jam or break. DO NOT FORCE THE HEAD AS IT MAY BE AT ITS LIMIT OF TRAVEL.
   f. Check to ensure that nothing interferes with the wiring harness that delivers signals to the head as it travels across the paper.

RIBBON

The Bell & Howell P-150 is shipped from the factory with a ribbon installed. The ribbon is held in place by two spring clips located on each side frame of the mechanism. Verify that the ribbon cartridge is secured by these spring clips and that the nylon ribbon passes through the right guide post on the print head. (See Figure 3A)

The P-150's ribbon features a mobius loop. The ribbon has been constructed by holding one end fixed, rotating the opposite end through 180 degrees, and applying it to the opposite end. Such construction ensures extended life for the ribbon as it effectively uses the ribbon's entire surface area.

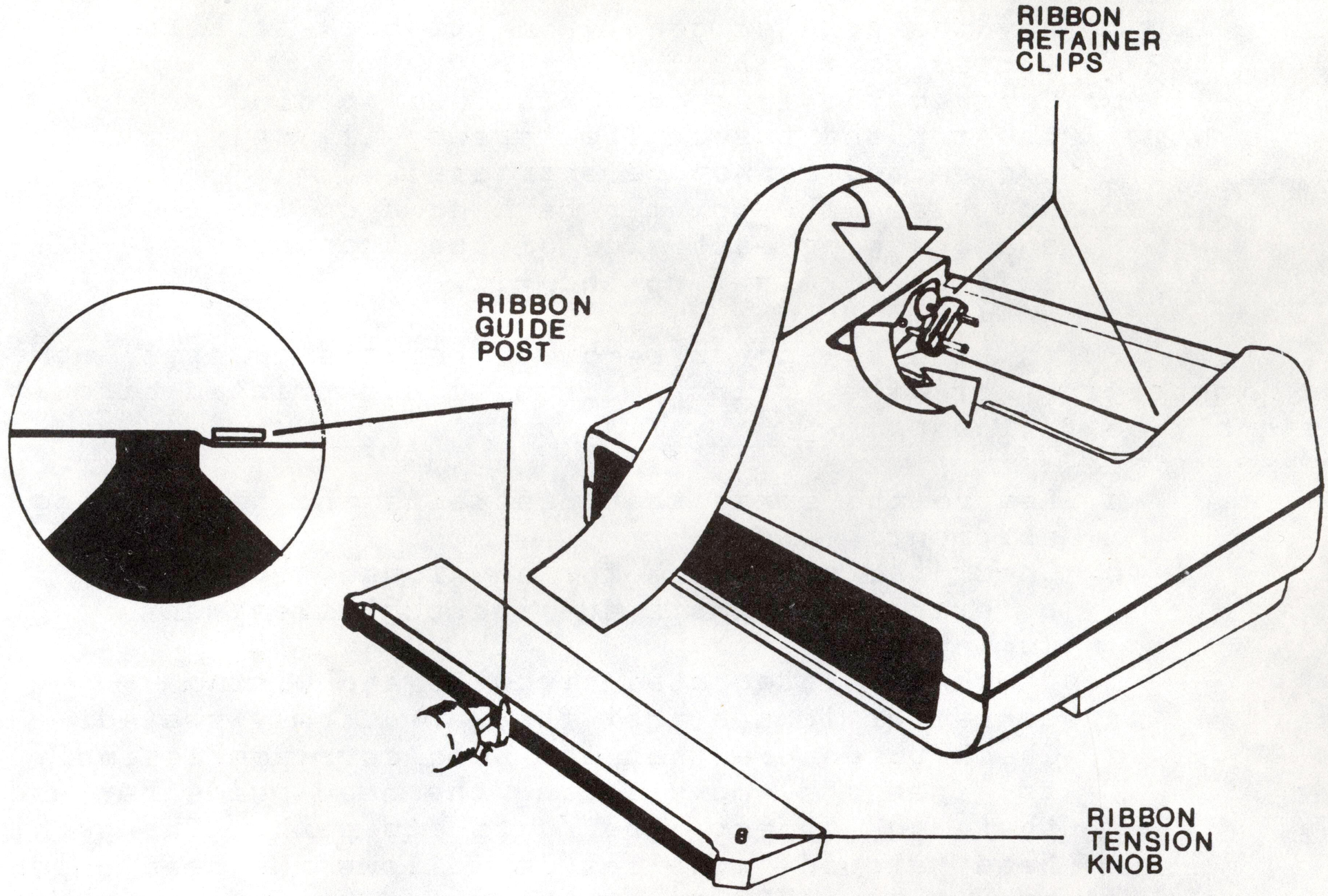


FIGURE 3A
Ribbon Carriage Installation

PAPER ALIGNMENT

Open the tractor doors.

Paper is fed through a slot located underneath and to the rear of the printer. Pass the paper through the slot keeping the paper to the left side of the printer to be sure it actuates the paper out switch. As the paper is brought up, the Out Of Paper switch will rotate away from its contact. Guide the paper behind the ribbon and pull up enough paper for alignment. (See Figure 4A)

Release the locking lever on the tractors and adjust the tractors for the correct paper width making sure that the paper is correctly positioned for the first print

column. Tighten the locking lever after you have made this adjustment. The leading edge of the paper should be square with the sides. Place the corresponding pin holes in the two tractors with the same relative holes in the paper.

Close the tractor doors to secure the paper.

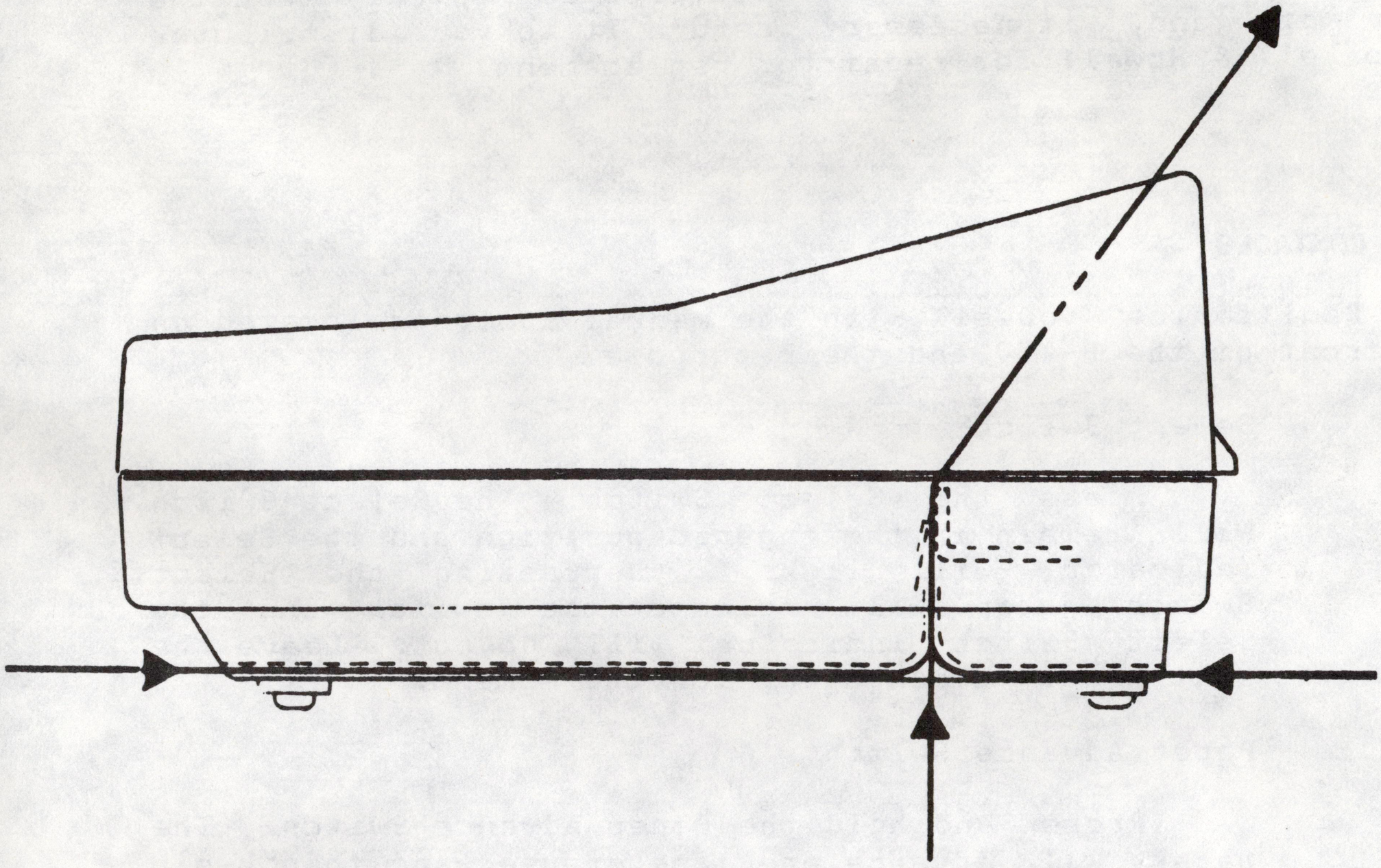


FIGURE 4A
Paper Paths

POWER CONNECTION

If the unit is configured to operate from a 230 VAC power source, VERIFY THE CORRECT TRANSFORMER CONNECTIONS BEFORE APPLYING POWER. Otherwise, plug in the power cord to 115 volt AC power. The printer is supplied with a grounded three wire plug, do not use the printer with an adapter plug unless you are certain that the adapter plug is properly grounded. Do not remove the third grounding plug from the cable.

POWER ON

Turn the printer on using the Power Switch located underneath the printer on the right side approximately 4

inches from the front. The Power Switch is a rocker type switch. When power is turned on, the P-150's head will move. If you have the optional SoftSwitch Status Keypad installed, a musical tone will be heard. The Power On Indicator will light for all models.

In the event of any obvious problems quickly turn the power off and, if necessary, return it to your distributor or to Bell & Howell for repair or replacement.

MANUAL CONTROLS

Familiarize youself with the manual controls located on the front of the P-150 and their purpose.

Select Switch

Press the Select Switch. The Select Switch will remain in the engaged position and the Select Indicator will light. Depressing the Select Switch again will release the switch and the Select Switch Indicator will go out. Leave the switch out (disengaged) for the moment.

Paper Advance Switch

Press and hold the Paper Advance Switch. The paper wll advance one line, pause, and then begin to advance paper steadily at approximately 10 lines per second. If the switch is released, the paper will stop advancing. The paper will stop automatically when it reaches the next 'Top of Form' position.

Top of Form Switch

Advance the paper to the position you want as the Top of Form. To set the Top of Form, depress and release the TOF Set Switch. If the Top of Form Switch is held in the depressed position, the paper will advance in one dot position (approximately .014") increments for fine alignment. The Top of Form is now set. NOTE: The printer must be DESELECTED, i.e., the Select Switch must be disengaged (out) and the Select Indicator off, whenever you want to set the Top of Form.

Now engage the Select Switch. The Select Indicator will light.

With the Select Switch engaged, you may run the P-150's self test by depressing and holding the Paper Advance Switch and the TOF Set Switch simultaneously. The P-150 will print a line of characters for pattern verification.

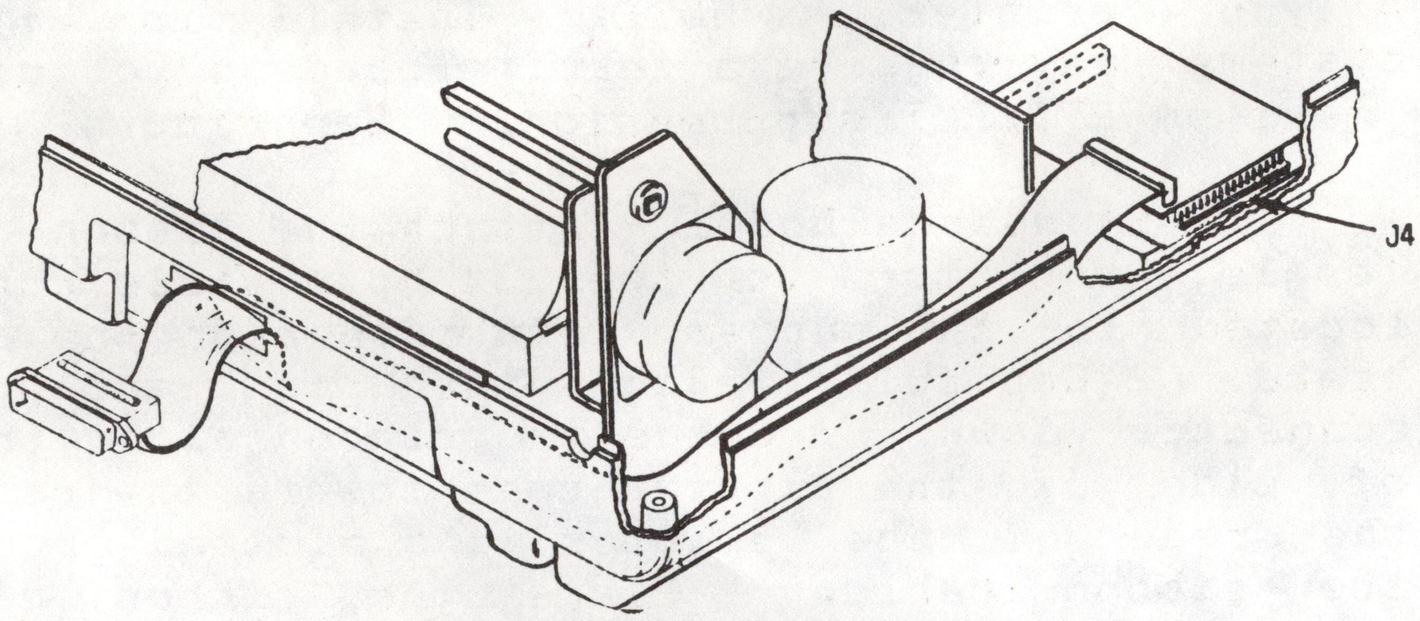


FIGURE 5A. Installation of Serial Communications Interface Adapter

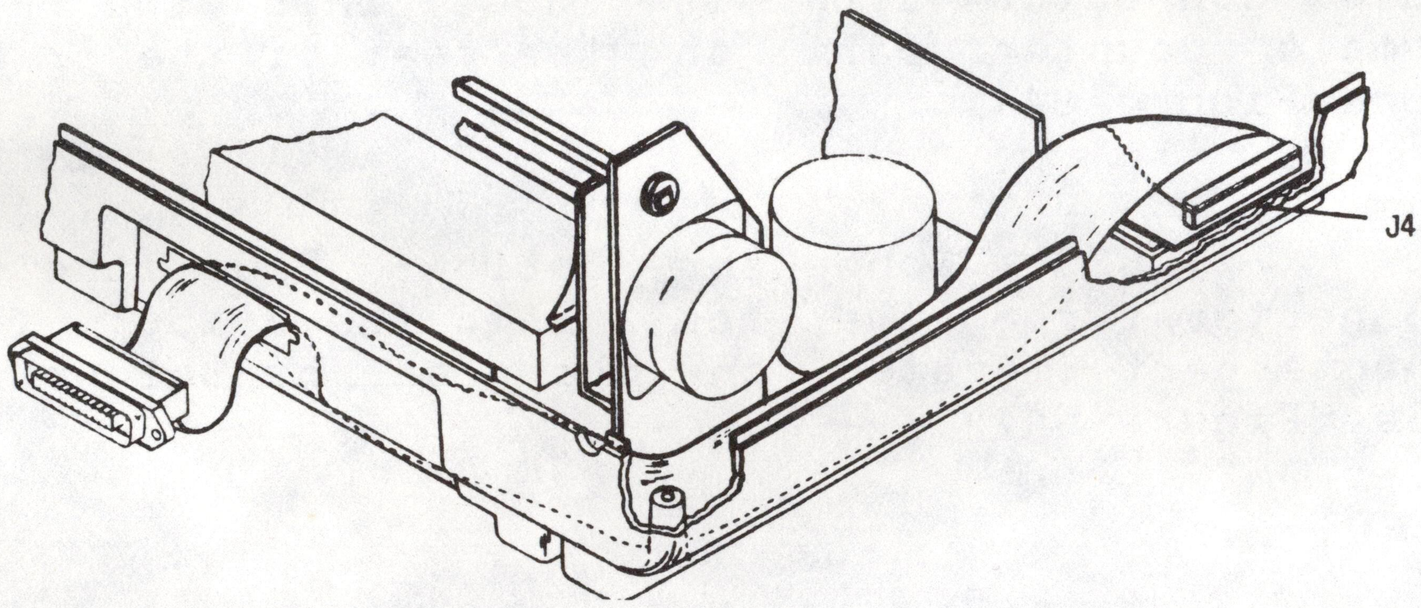
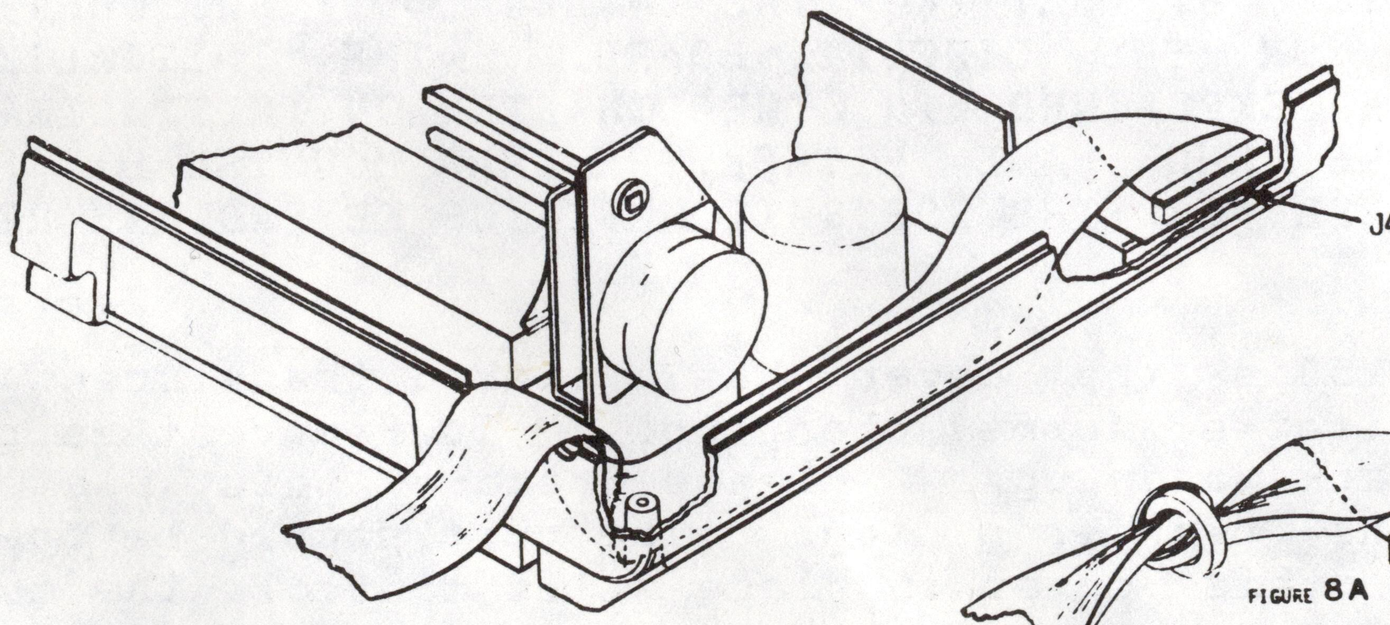


FIGURE 6A. Installation of "Centronics" Connector



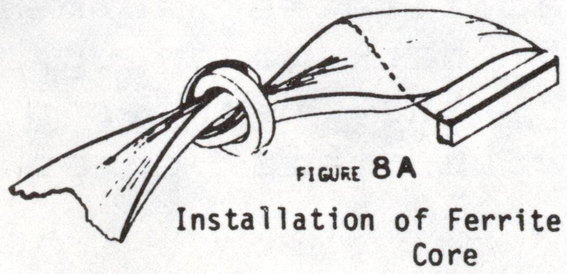


FIGURE 8A
Installation of Ferrite Suppression Core

FIGURE 7A. Installation of Parallel I/O Cable

CONNECTION TO HOST

Depending on the options you selected for your P-150 you will follow ONLY one of the next three procedures. Choose the procedure based on the type of connector you ordered on your printer. NOTE: Installation with some computer systems may require a ferrite bead to be installed to achieve maximum RFI/EMI suppression. (See Figure 8A)

Standard Model - Attach the ribbon cable's female connector to the 34 pin male connector located in the upper left corner on the circuit board. Carefully align the pins and push the connector down. Guide the ribbon along the left of side of the printer case toward the rear. On the rear of the printer is a slotted groove for the ribbon cable. Place the ribbon cable in position. (See Figure 7A)

Centronics Connector Option- Plug the male connector from the host into the P-150's female counter part on the rear of the printer. (See Figure 6A)

DB25 Connector Option- Plug the male connector from the host into the P-150's female counterpart located on the rear of the printer. (See Figure 5A)

COVER REPLACEMENT

NOTE: IF YOU HAVE THE MODEL OF THE P-150, WITHOUT THE SOFTSWITCH FRONT PANEL, YOU SHOULD NOT REPLACE THE PRINTER'S COVER AT THIS TIME. IT IS NECESSARY TO INITIALIZE THE P-150 AND ESTABLISH THE DIFFERENT MODES AND PRINTING CHARACTERISTICS BY SETTING THE INTERNAL DIP SWITCHES WHICH ARE LOCATED ON THE CIRCUIT BOARD. THE INITIALIZATION PROCEDURE IS EXPLAINED IN THE CHAPTER ON INITIALIZATION. THOSE PERSONS WHO HAVE EITHER THE REAR MOUNTED DIP SWITCH EXTENDER PANEL OR THE SOFTSWITCH STATUS KEYPAD MAY REPLACE THE COVER.

The P-150's top cover has a smoked translucent plate which facilitates forms changing. To remove this plate, slide it back and up. Please remove this plate when replacing the printer's top. The unit should be operated always with this cover in place as it controls the cooling air flow.

Move the paper out of the way and position the printer's top onto the printer's base. Be certain that the ribbon cable on the standard model is aligned on the rear slot formed by the top and bottom pieces.

When you have properly positioned the printer cover, raise the printer slightly on one side and tighten the two retaining screws. Now raise the other side and tighten the two remaining screws.

Lay the paper toward the rear of the printer and replace the brown translucent plate onto the printer's top by sliding it down and forward until you feel it latch into place. Do not operate the printer without the plate in place as it directs air flow from the fan to cool the print head.

You are now ready to initialize your P-150.

Appendix 2

Graphic Patterns

The following table shows the bit patterns that correspond to the appropriate characters. In all cases, the decimal value necessary to generate this character is given. Where there is a printable character that corresponds to the bit pattern, it too is given.

B6	-	-	-	-	-	-	-	-
B5	-	-	-	-	-	-	-	-
B4	-	-	-	-	-	-	-	-
B3	-	-	-	-	o	o	o	o
B2	-	-	o	o	-	-	o	o
B1	-	o	-	o	-	o	-	o
Decimal	64	65	66	67	68	69	70	71
Char.	@	A	B	C	D	E	F	G
B6	-	-	-	-	-	-	-	-
B5	-	-	-	-	-	-	-	-
B4	o	o	o	o	o	o	o	o
B3	-	-	-	-	o	o	o	o
B2	-	-	o	o	-	-	o	o
B1	-	o	-	o	-	o	-	o
Decimal	72	73	74	75	76	77	78	79
Char.	H	I	J	K	L	M	N	O
B6	-	-	-	-	-	-	-	-
B5	o	o	o	o	o	o	o	o
B4	-	-	-	-	-	-	-	-
B3	-	-	-	-	o	o	o	o
B2	-	-	o	o	-	-	o	o
B1	-	o	-	o	-	o	-	o
Decimal	80	81	82	83	84	85	86	87
Char.	P	Q	R	S	T	U	V	W

B6	-	-	-	-	-	-	-	-
B5	o	o	o	o	o	o	o	o
B4	-	-	-	-	-	-	-	-
B3	-	-	-	-	o	o	o	o
B2	-	-	o	o	-	-	o	o
B1	-	o	-	o	-	o	-	o
Decimal	88	89	90	91	92	93	94	95
Char.	X	Y	Z	[		]	^	
B6	o	o	o	o	o	o	o	o
B5	-	-	-	-	-	-	-	-
B4	-	-	-	-	-	-	-	-
B3	-	-	-	-	o	o	o	o
B2	-	-	o	o	-	-	o	o
B1	-	o	-	o	-	o	-	o
Decimal	96	97	98	99	100	101	102	103
Char.		a	b	c	d	e	f	g
B6	o	o	o	o	o	o	o	o
B5	-	-	-	-	-	-	-	-
B4	o	o	o	o	o	o	o	o
B3	-	-	-	-	o	o	o	o
B2	-	-	o	o	-	-	o	o
B1	-	o	-	o	-	o	-	o
Decimal	104	105	106	107	108	109	110	111
Char.	h	i	j	k	l	m	n	o

B6	o	o	o	o	o	o	o	o
B5	o	o	o	o	o	o	o	o
B4	-	-	-	-	-	-	-	-
B3	-	-	-	-	o	o	o	o
B2	-	-	o	o	-	-	o	o
B1	-	o	-	o	-	o	-	o
Decimal	112	113	114	115	116	117	118	119
Char.	p	q	r	s	t	u	v	w
B6	o	o	o	o	o	o	o	o
B5	o	o	o	o	o	o	o	o
B4	o	o	o	o	o	o	o	o
B3	-	-	-	-	o	o	o	o
B2	-	-	o	o	-	-	o	o
B1	-	o	-	o	-	o	-	o
Decimal	120	121	122	123	124	125	126	127
Char	x	y	z	{		}	//	

Appendix 3

ASCII CODE CHART

b7 → / b6 → / b5 →	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b4 b3 b2 b1 — COL / ROW	0	1	2	3	4	5	6	7
0 0 0 0	0 000 NUL 000	16 016 DLE 020	SP 032 040	0 048 060	@ 064 100	P 080 120	` 096 140	p 112 160
0 0 0 1	1 001 SOH 001	17 017 DC1 021	! 033 041	1 049 061	A 065 101	Q 081 121	a 097 141	q 113 161
0 0 1 0	2 002 STX 002	18 018 DC2 022	" 034 042	2 050 062	B 066 102	R 082 122	b 098 142	r 114 162
0 0 1 1	3 003 ETX 003	19 019 DC3 023	# 035 043	3 051 063	C 067 103	S 083 123	c 099 143	s 115 163
0 1 0 0	4 004 EOT 004	20 020 DC4 024	$ 036 044	4 052 064	D 068 104	T 084 124	d 100 144	t 116 164
0 1 0 1	5 005 ENQ 005	21 021 NAK 025	% 037 045	5 053 065	E 069 105	U 085 125	e 101 145	u 117 165
0 1 1 0	6 006 ACK 006	22 022 SYN 026	& 038 046	6 054 066	F 070 106	V 086 126	f 102 146	v 118 166
0 1 1 1	7 007 BEL 007	23 023 ETB 027	' 039 047	7 055 067	G 071 107	W 087 127	g 103 147	w 119 167
1 0 0 0	8 008 BS 010	24 024 CAN 030	(040 050	8 056 070	H 072 110	X 088 130	h 104 150	x 120 170
1 0 0 1	9 009 HT 011	25 025 EM 031	) 041 051	9 057 071	I 073 111	Y 089 131	i 105 151	y 121 171
1 0 1 0	A 010 LF 012	26 026 SUB 032	* 042 052	: 058 072	J 074 112	Z 090 132	j 106 152	z 122 172
1 0 1 1	B 011 VT 013	27 027 ESC 033	+ 043 053	; 059 073	K 075 113	[091 133	k 107 153	{ 123 173
1 1 0 0	C 012 FF 014	28 028 FS 034	, 044 054	< 060 074	L 076 114	/ 092 134	l 108 154	| 124 174
1 1 0 1	D 013 CR 015	29 029 GS 035	- 045 055	= 061 075	M 077 115	] 093 135	m 109 155	} 125 175
1 1 1 0	E 014 SO 016	30 030 RS 036	. 046 056	> 062 076	N 078 116	^ 094 136	n 110 156	~ 126 176
1 1 1 1	F 015 SI 017	31 031 US 037	/ 047 057	? 063 077	O 079 117	_ 095 137	o 111 157	127 177

b7 is the most significant bit, b1 is the least significant bit. For example, the HEX value for the character M is 4D. The DECIMAL value for each character is at the top of each square. The OCTAL value is located at the bottom. When the upper left hand corner of a square is blackened, the character in that square is a command used by the Bell & Howell Model P-150.

REFERENCE CARD

INTERNAL SWITCH SETTINGS

FONT SELECT — SW1-1, SW1-2

AUTO LINE FEED — SW1-3
ON = Carriage Return Advances Paper

FORM LENGTH SELECT
Set by SW2- (1=ON) or by Command

Length	#4	#3	#2	#1	Char	OCT	DEC	HEX
0"	1	1	1	1	0	060	48	30
3.0"	1	1	1	0	1	061	49	31
3.5"	1	1	0	1	2	062	50	32
4.0"	1	1	0	0	3	063	51	33
4.5"	1	0	1	1	4	064	52	34
5.0"	1	0	1	0	5	065	53	35
5.5"	1	0	0	1	6	066	54	36
6.0"	1	0	0	0	7	067	55	37
7.0"	0	1	1	1	8	070	56	38
8.0"	0	1	1	0	9	071	57	39
8.5"	0	1	0	1	:	072	58	3A
9.5"	0	1	0	0	;	073	59	3B
10"	0	0	1	1	<	074	60	3C
11"	0	0	1	0	=	075	61	3D
12"	0	0	0	1	>	076	62	3E
14"	0	0	0	0	?	077	63	3F

AUTOMATIC PERFORATION SKIP — SW2-5
ON = Skip

LINE SPACING SELECT — SW2-6
ON = 8 Lines Per Inch, OFF = 6 LPI

CHARACTER DENSITY SELECT

Char./Line	Font	SW2-7	SW2-8
136	7x9	ON	ON
163	7x9	ON	OFF
136	11x9	OFF	ON
231	7x9	OFF	OFF

PROGRAMMING COMMANDS

COMMAND	CHAR	OCT	DEC	HEX
Carriage Return	CR	015	13	0D
Line Feed	LF	012	10	0A
Form Feed	FF	014	12	0C
Begin Underlining	SO	016	14	0E
End Underlining	SI	017	15	0F
Back Space	BS	010	08	08
Horizontal Tab	HT	011	09	09
Vertical Tab	VT	013	11	0B
Escape (Must Precede All Following Commands)	ESC	033	27	1B
Print	SO	016	14	0E
Elongated	N	116	78	4E
Stop	SI	017	15	0F
Elongated	O	117	79	4F
Skip Over Perf Disable	SYN	026	22	16
	V	126	86	56
Skip Over Perf Enable	NAK	025	21	15
	U	125	85	55
Print Graphics	ETB	027	23	17
	W	127	87	57
Set 6 Lines Per Inch	DC4	024	20	14
	T	124	84	54
Set 8 Lines Per Inch	DC3	023	19	13
	S	123	83	53
Set 204 Columns (Graphics = 75 DPI)	ESC	033	27	1B
	[	133	91	5B
Set 136 Columns (Graphics = 50 DPI)	FS	034	28	1C
	\	134	92	5C
Set 163 Columns (Graphics = 60 DPI)	GS	035	29	1D
	]	135	93	5D
Set Serif Font (Graphics = 80 DPI)	RS	036	30	1E
	^	136	94	5E
Set 231 Columns (Graphics = 85 DPI)	US	037	31	1F
	_	137	95	5F
Set Horizontal Tab	HT	011	09	09
	I	111	73	49
Set Vertical Tab	VT	013	11	0B
	K	113	75	4B
Load 7 Wide Font	BS	010	08	08
	H	110	72	48
Load 11 Wide Font	ACK	006	06	06
	F	106	70	46
Use Alternate Font	STX	002	02	02
	B	102	66	42
Use Internal Font	ETX	003	03	03
	C	103	67	43
Clear Alternate Font	CAN	030	24	18
	X	130	88	58